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Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
VOL. LIV. No. 1.

THE PARASITIC HYMENOPTERA OF THE TERTIARY OF FLORISSANT, COLORADO.

BY CHARLES T. BRUES.

WITH ONE PLATE.

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No. 1.—*The Parasitic Hymenoptera of the Tertiary of Florissant, Colorado.*

By Charles T. Brues.

The present paper is based upon studies on the parasitic Hymenoptera contained in the very extensive collection of fossil insects made many years ago by Dr. Samuel H. Scudder at Florissant, Colorado, and now contained in the Museum of Comparative Zoölogy. In addition, Prof. T. D. A. Cockerell has sent me much material from the same locality obtained by expeditions under his charge during the summers of 1907 and 1908, most of this second series belonging to the American Museum of Natural History. In all I have had the opportunity to examine over 700 well-preserved specimens of insects belonging to this group, among which there are 112 clearly defined species which are described on the following pages. Adding to these the 13 species previously described by Professor Cockerell and the present writer, the total number so far found at Florissant is 125.

The very large number of species of parasitic Hymenoptera represented at Florissant shows it to be by far the richest locality in the world for these insects, as it has already been found to be by Scudder for many other groups. This is shown in the following table which gives a comparison between the several important places where fossil parasitic Hymenoptera have been found.

Number of Tertiary species of parasitic Hymenoptera found in various localities.

Horizon	Locality	Proctotrypoidea	Cynipoidea	Chalcidoidea	Ichneumonidae	Braconidae	Evaniidae	Stephanidae	Totals
Miocene	Florissant	5	3	15	76	23	2	1	125
Upper Miocene	Oeningen	0	0	1	6	0	0	0	7
Lower Miocene	Radoboj	0	0	0	5	0	0	0	5
Lower Oligocene	Baltic Amber	1	3	12	15	6	2	0	39
Lower Oligocene	Aix, France	0	0	1	9	2	0	0	12

With the exception of a single genus and species (Ephialtites) from the Upper Jurassic, no parasitic Hymenoptera are known before the Tertiary. However, the quite typical character of Ephialtites, and the abundance in which the group appears in deposits of Lower Oligocene age show that it must have been clearly differentiated and well developed at least before the beginning of the Tertiary. The discovery of Ephialtites in rocks so much older than those in which other of the higher Hymenoptera have been found has led Handlirsch to derive both the parasitic and aculeate Hymenoptera from this type. In this I cannot agree with him and strongly suspect that the greater antiquity of Ephialtites, if it be a truly ichneumonoid form, must be only apparent, and due to our very imperfect knowledge of the earlier fossil insects. However this may be, we know from the Oligocene and Miocene an extremely large fauna which must of course represent only a small fragment of what actually existed. It will be seen from the taxonomic part of this paper that many species are known only from single specimens, which agrees well with what we find in collections of recent species belonging to this group, and evidences not only their very general occurrence but their high degree of differentiation into numerous closely allied species.

The beautiful preservation of most of the Florissant species makes it possible to refer the great majority of them to living genera with a considerable degree of certainty — that is of course speaking of recent genera in the wide sense as used by the older writers. In some cases it has been possible to place species with still greater certainty, and in these cases the name of the more modern subdivision or genus in the restricted sense has been employed. Even in the case of specimens too poorly preserved to describe, I have rarely been in doubt as to the family to which they should be referred, and well-preserved specimens are usually easily placed in the subfamilies and genera if one is familiar with the details of structure in modern forms, and willing to scrutinize the fossils with great care. This last is extremely important for one is often badly deceived at first sight by obliterated or unduly prominent structures.

On the whole, the wings are the most important characters to be studied. They are usually well preserved, generally lying between the laminae of the shale where it splits in exposing the specimen. Very few specimens show well-preserved legs, although the hind femora and tibiae often show quite prominently. As a rule the specimens can be studied advantageously under a rather strong magnification, and most of those which I have described were examined under a compound microscope with two-thirds objective and two inch eyepiece.

Since many of the details are indicated by color rather than surface structure, it is necessary to examine both by obliquely reflected light and by as nearly vertical illumination as possible. The latter can be obtained either by using an objective furnished with a prism for vertical illumination, or by placing on the stage of the microscope around the specimen, the rim of a deep pillbox from which the bottom has been removed. This simple device shuts off all very oblique light and renders visible wing venation and other characters which are otherwise often very difficult to make out.

One of the most remarkable facts connected with the preservation of the Florissant insects is the apparent fidelity with which colors are usually preserved or indicated. It is not so difficult to understand the preservation of metallic colors which are dependent upon physical structure, but the distinction between red, black, and yellow is usually also retained as well as the difference between hyaline and infuscated wings. This is proven beyond all doubt by the similar color of different specimens belonging to the same species, and the general color tendencies of fossil species as compared with those of recent related forms. In a small proportion of the specimens carbonization has proceeded to the point of blackening the entire specimen but this is unusual. There is probably no doubt that a part of the color differentiation both in recent and fossil insects of these groups is dependent upon the thickness of the chitin covering the different parts of the body, and it is much easier to see how this may have been preserved than to understand the retention of actual pigment colors or their proper representation. The peculiar method of entombment of these fossils must be, I think, in great part responsible for this. The volcanic ash of which the matrix was formed, was evidently very fine, and its similarity to cement rock has led me to believe that the rapidity with which it originally hardened must have been very great. This would account in great measure for the failure of the chitin to macerate as it will do in the presence of much water, and perhaps also for the presence of pigment. In his Tertiary Insects ('90, p. 24) Scudder quotes Dr. M. E. Wadsworth who examined specimens of these insect-bearing shales, to the effect that they probably originated from a moya, or mudflow which was rapidly deposited in the shallow waters of the Florissant lake without any preliminary erosion. That the deposition and hardening of the shales was unusually rapid seems to me undoubted, for in no other way can I account for the presence of pigmental colors and the preservation of microscopic structures like wing hairs with such wonderful perfection.

The distribution of the Miocene parasitic Hymenoptera among the various groups is very interesting and I have attempted to represent graphically in the accompanying diagram (Plate 1) the comparative abundance of the several families and smaller groups during Recent, Miocene, and Oligocene times. In order to make the diagram more easily understood, the comparative numbers and not the actual ones are shown by the width of the black lines for each period since the numbers of species known vary much in proportion for the three periods.[1]

Only one family, the Ichneumonidae, was proportionately more abundant in Miocene times than at present and its abundance was caused entirely by the occurrence of a much larger number of species in two of its subfamilies, the Ophioninae and Pimplinae; the other three subfamilies, Ichneumoninae, Cryptinae, and Tryphoninae were about as well represented then as now. The Braconidae appear to have become less numerous, and I believe the change has been even greater than is shown by the diagram, since fossil Braconidae are usually more poorly preserved than the Ichneumonidae, due probably to their softer bodies and wings. The Evaniidae appear to have become less abundant in recent times, but this may possibly be due to the small number of species on which the calculation is based. The Chalcidoidea (exclusive of the Mymaridae which are omitted on account of their disproportionate abundance in amber) seem to be on the ascendent, but the number of species of Proctotrypoidea and Cynipoidea is so small that they do not furnish a satisfactory basis for any deductions of this nature.

I have not been able to find much evidence bearing on the probable relationships of the Florissant fauna from a study of the Parasitic Hymenoptera. This is disappointing, but really to be expected, for the group, with minor exceptions, is very widely distributed at the present time and extremely similar the World over. A few points of interest may however be worthy of review. The occurrence of a fig insect shows a tropical element in the fauna, but only serves to strengthen the evidence offered by the presence of fossil fig leaves in the flora. Australian and South African affinities are suggested by the occurrence of Leptobatopsis and Ormyrodes respectively, but these may have no general significance, and I do not believe that they have. The abundance of Ophioninae and Pimplinae, particularly of the former, would appear to be expressions of Neotropical tendencies, and I think they may quite probably be so.

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[1] I have used as a basis for the number of recent species, Cresson's Catalogue of North American Hymenoptera. It is now rather old, but I think the proportion of species to be placed in the several families has not changed materially since the time of its publication.

The exact relationships of the present fauna of the United States and of that of Florissant during Miocene times can be traced in the accompanying table. The number of fossil species are contrasted with the number of recent species occurring in the United States (according to Cresson, 1888) and the third column of figures gives the proportionate number of species in the two faunae.

GROUP	Number of recent species in the U. S.	Number of fossil Florissant species	Proportionate number.
Proctotrypoidea	75	5	100:6.6
Cynipoidea	191	3	100:1.5
Chalcidoidea	413	15	100:3.6
Evaniidae	31	2	100:6.4
Ichneumonidae	1326	77	100:5.6
Ichneumoninae	343	13	100:3.8
Cryptinae	280	6	100:2.1
Pimplinae	211	17	100:8.0
Tryphoninae	249	13	100:5.2
Ophioninae	243	28	100:11.5
Alysiidae	40	2	100:5.0
Braconidae	292	19	100:6.5
Stephanidae	4	1	100:25.0

The designation of the special localities for certain of the species collected by Professor Cockerell's expeditions is in accordance with his numbers of stations as given in one of his recent papers (**:07**). The specimens in the Scudder collection have no indication of which specific localities or beds they were taken from, except that all were taken from the Florissant lake basin.

I wish to gratefully acknowledge the courtesy of the authorities of the Museum of Comparative Zoölogy for the loan of the Scudder collection and the assistance given by Professor Cockerell who first suggested to me the great interest attaching to the Florissant fauna, and who aided by the sending of much material. I am indebted to Dr. H. C. Bumpus and Mr. R. W. Miner of the American Museum of Natural History for the fine figures of the types belonging to that institution, which they had made as illustrations.[1]

The task of working up the material has consumed much more time than I anticipated when I undertook it fully two years ago, due not only to many interruptions, but to the necessarily slow methods of studying and comparing the specimens which belong to a group unusually difficulty to classify. For these reasons the work has been very tedious but I hope that future students may not be misled into thinking it uninteresting. On the contrary, it is extremely fascinating.

BETHYLIDAE.

Handlirsch in his recent work (:07) on fossil insects records the presence of a species of this family in Baltic Amber and I have already figured (:06) a strange species from Florissant which most likely is a bethylid.

In the present series there is one very finely preserved species belonging to the genus Epyris.

Epyris deletus, sp. nov. (Fig. 1.)

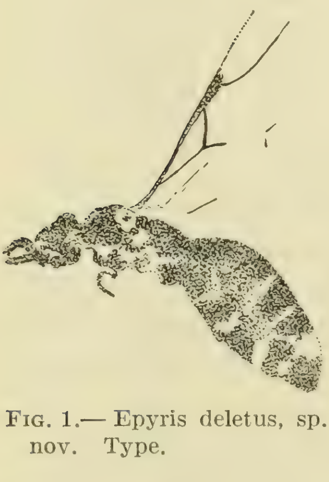

Fig. 1.— Epyris deletus, sp. nov. Type.

Female. Length 5.5 mm. Black; the antennae brownish, except at the base, and the abdomen brownish toward the tip. Head (as preserved) but slightly wider than long. Antennae of the typical attenuated form, stout basally and involute, the number of joints not ascertainable; those near the middle quadrate. Surface of head faintly shagreened. Prothorax about one-third longer than the mesonotum, which seen from the side is about as long as the metanotum. The latter carinate laterally, i. e. with a raised margin, its lateral angles rather prominent, quadrate. Abdomen slightly longer than the head and thorax together, seen from the side of the typical form or perhaps slightly more slender or elongate. Legs, except one of the anterior ones not preserved; this is very strongly incrassated, and brownish yellow on the tibia and tarsus. Wings hyaline, with elongate, narrow, fuscous stigma; two basal cells; marginal cell open, but the radial vein is very long, four or five times as long as the short basal vein; veins, except the costal, pale.

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[1] The manuscript of the present paper was completed before the writer severed his connection with the Milwaukee Public Museum, and he wishes to take this opportunity to thank Mr. H. L. Ward, the Director of the Museum, for the interest taken by him in the progress of the work.

One specimen, No. A3, very nicely preserved in lateral aspect from Professor Cockerell's Station No. 17. Type in the Amer. Mus. Nat. Hist.

This is a very typical bethylid and is perhaps better referred to Mesitius than to Epyris. As however, Kieffer believes that the American recent species of Mesitius which this approaches in the short basal and long radial veins are not generically distinct from Epyris, I have placed it here. The scutellar fovea, which is the only character to distinguish the two genera as restricted by Ashmead does not show, and Kieffer restricts Mesitius to a group of species with the lateral angles of the metathorax produced, to which the present form certainly does not belong.

CERAPHRONIDAE.

A single species belonging to Ceraphron is recorded by Burmeister (**'31**) as occurring in Baltic Amber.

PROCTOTRYPIDAE.

This group as here restricted is for the first time recorded in the fossil state.

Proctotrypes exhumatus, sp. nov. (Fig. 2.)

Female. Length 5.5 mm. Black, the abdomen reddish except at the base and the tip of the terebra, the black extending farther back on the venter than on the dorsal surface, although the tips of the second and third segments appear to be blackened above. Antennae 13-jointed, the first flagellar joint

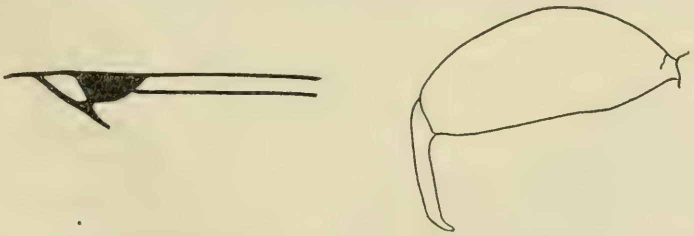

Fig. 2.— Proctotrypes exhumatus, sp. nov. Portion of wing and profile of abdomen of type.

one and one-half times as long as the second; second and the ones immediately following between two and three times as long as thick. Head not thick anteroposteriorly. Metanotum and metapleurae irregularly rugose; the mesonotum without distinct parapsidal furrows. Base of second abdominal segment fluted along the sides; terebra a little shorter than the posterior tibia, the last abdominal segment being much extruded also. Spur of posterior tibia indistinctly preserved. Wings more or less infuscated toward the middle. Costal cell present; veins and stigma dark, marginal cell rather small, shorter than the stigma. This is a typical representative of the genus closely allied to the recent *P. caudatus* Say.

Six specimens.

Type.— No. 2055, M. C. Z., Florissant, Col. (No. 4391, S. H. Scudder Coll.). Other specimens, M. C. Z., Nos. 2056–2059, Nos. 845, 8389, 10894, 8111, S. H. Scudder Coll.); and A 97 from Professor Cockerell, the latter in the Amer. Mus. Nat. Hist.

The specimen from Professor Cockerell was collected by Mr. S. A. Rohwer at Station 13. M. C. Z., No. 2059 (No. 8111 S. H. Scudder Coll.) may not be the same species as the terebra and last abdominal segment are more strongly exserted and apparently longer.

BELYTIDAE.

This family is known fossil only at Florissant so far as I am aware, although some of the earlier references to Proctotrypidae may possibly be based on members of the present group. In addition to *Pantoclis deperdita* Brues (:06), I have the following:

Belyta mortuella, sp. nov. (Fig. 3.)

Male. Length 2.25 mm. Probably entirely dark colored, black or piceous, perhaps the legs and antennae a little lighter. Antennae as long or somewhat exceeding the body in length, filiform but rather stout, the extreme apex not preserved. Several joints before the middle of the flagellum subequal, each about four times as long as thick, those following to near the tip similar but somewhat shorter. Body shining, the mesonotum with deep and complete parapsidal furrows; metathorax carinated and quite distinctly areolated on the sides. The specimen is seen in

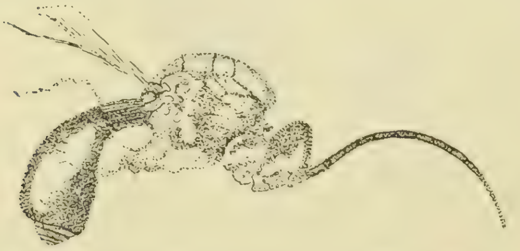

FIG. 3.— Belyta mortuella, sp. nov. Type.

lateral view and the absence or presence of a median carina cannot be made out. Abdomen nearly as long as the head and thorax together, the petiole nearly twice as long as thick, coarsely striated. Second segment very large, covering nearly the entire surface; entirely smooth, following all short, transverse-linear, together only about one-sixth the length of the second. Wings and legs not preserved.

One specimen, A32, collected by Mr. S. A. Rohwer at Station No. 14. Type in the Amer. Mus. Nat. Hist.

This is a typical belytid, not very readily assignable with assurance to any particular genus, and therefore left in Belyta, *sensu lato*.

DIAPRIIDAE.

Two genera, one of them new, are represented each by a single species in the present series from Florissant.

PARAMESIUS DEFECTUS, sp. nov. (Fig. 4.)

Female. Length 4–5 mm. Black; antennae at base and legs reddish brown. Antennae probably 13-jointed, gradually clavate, all of the flagellar joints however longer than wide. Thorax oval, rather long, the mesonotum with complete but rather delicate parapsidal furrows. Scutellum with a large, broad transverse median fovea at the base. Metathorax very short, with three longitudinal carinae. Abdomen rather short, twisted at the base in the type so that the petiole is not preserved; broadest just beyond the middle. Wings slightly, but distinctly infuscated; submarginal vein long, two-thirds the length of the wing, stigmated. Basal vein obsolete. Legs long and slender.

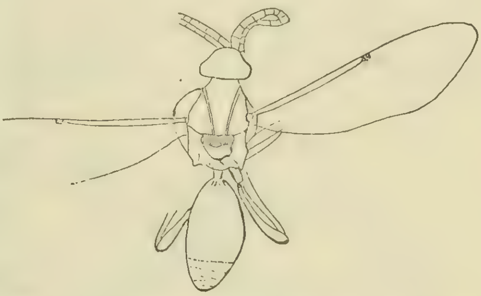

FIG. 4.— Paramesius defectus, sp. nov. Type.

One specimen.

Type.— No. 2061, M. C. Z., Florissant, Col. (No. 13,394, S. H. Scudder Coll.). The specimen is not well preserved, but undoubtedly is a member of this genus or of a very closely related one. The head of the type is peculiarly constricted, but I think this is undoubtedly due to the pressure of the matrix.

GALESIMORPHA, gen. nov.

Head produced as in Galesus, elongate. Wings with a submarginal vein distinct from the margin, ending in a stigma at one-half the length of the wing. Basal vein very distinct.

Type.— *G. wheeleri*, sp. nov.

This is very much like Galesus to which it appears to be more closely related than to any other genus so far described, but differs by its distinctly veined wings.

GALESIMORPHA WHEELERI, sp. nov. (Fig. 5.)

Female. Length 3.3 mm. Black, with the legs and antennae brownish. Head longer than wide when seen from above, the ledge above the antennae emarginate on each side of the middle which is produced as a tooth; just at the middle the head is strongly constricted. Mesonotum shining, convex, with two strong, complete parapsidal furrows distinctly convergent behind. Scutellum large, with a large fovea on each side at the middle, the two con-

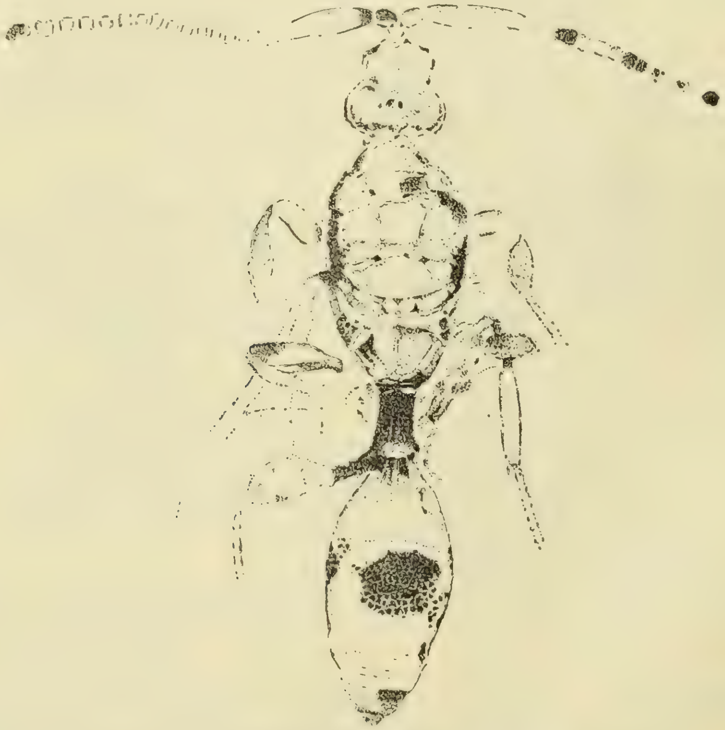

FIG. 5.— Galesimorpha wheeleri, sp. nov. Type.

nected by an impressed arcuate line which bows forward nearly to the base of the scutellum. Postscutellum with a pair of median foveae basally, a posterior impressed line and an oblique impressed line. Metathorax short, smooth, with three longitudinal carinae, the median one not furcate. Abdomen as long as the head and thorax together, rather slender; petiole one-third as long as the abdomen, longitudinally fluted. Second segment three times as long as the following together, less than one-half as broad as long and coarsely striated at its extreme base. Wings faintly infuscated; submarginal vein about one-half as long as the wing. Legs long and slender, clavate.

One specimen, beautifully preserved, No. A52, collected at Station 13 by Prof. W. M. Wheeler. Type in the Amer. Mus. Nat. Hist. In general appearance it is very much like a true Galesus.

FIGITIDAE.

The single species of this family in the present collection seems to be the first one discovered in the fossil state.

Figites solus, sp. nov. (Fig. 6.)

Male. Length 2.7 mm. Probably entirely black, except metathorax, base of abdomen, and the legs which are rufous or dark reddish brown. Antennae dark brown, 13-jointed, slender, the club very slightly thickened, two-jointed, its second joint shorter and narrower than the first. First flagellar joint long, fully twice as long as the second which is equal to the pedicel; following to the club about equal, ovate in form. Thorax seen in latero-dorsal view, enough of the dorsum being visible to show the presence of parapsidal furrows, and the probable absence of a cupuliform shape to the scutellum. Abdomen subsessile, about as long as the head and thorax together, apparently not pubescent at the base, although this character may have been lost in the process of preservation. Legs rather stout for this group. Wings hyaline, the veins pale brown; radial cell apparently about two times as long as wide.

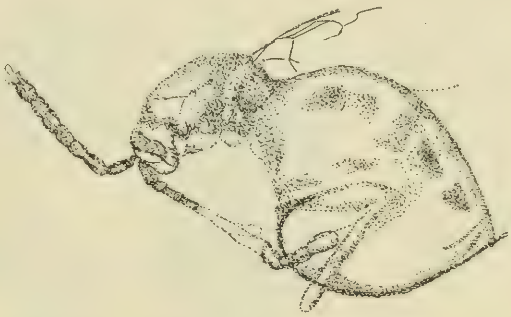

Fig. 6.— Figites solus, sp. nov. Type.

One specimen, A60 collected by Mr. S. A. Rohwer at Station 17. Type in the Amer. Mus. Nat. Hist.

Although quite well preserved, I can refer the species to Figites only in the wide sense. The slender antennae seem to exclude it from the Eucoilinae.

CYNIPIDAE.

Cynips has been twice recorded from Amber, first by Schlotheim ('20) and later by Presl ('22). Menge ('56) notes the presence of the family in Amber, and Gravenhorst ('35) mentions Diastrophus (Diplolepis) from the same source.

From Florissant I have representatives of two of the three subfamilies recognized by Ashmead, the Cynipinae and the Ibaliinae.

CYNIPINAE.

There are in the collection four species which I take to be true gall-flies, but from lack of personal knowledge, I have left them undescribed. A single specimen, however, which appears to represent a leaf gall, is I think worthy of specific record.

ANDRICUS MYRICAE, sp. nov. (Fig. 7.)

Gall regularly elliptic when seen from above, 6 mm. long and 3.5 mm. wide, placed next to the midrib of a leaf of either *Myrica obscura* Lx. or *Myrica drymeja* (Lx.) Knowlton (*M. fallax*), at a point where the leaf is about 13 mm. broad. Curiously enough Lesquereux has figured a leaf of *M. fallax* with gall-like excrescences upon it similar to this one in his Cretaceous and Tertiary Flora ('83, pl. XXXII, fig. 14).

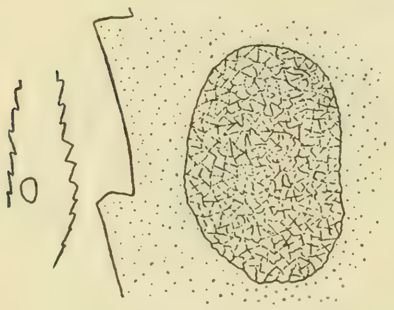

Fig. 7.— Andricus myricae, sp. nov. Type.

One specimen.

Type.— No. 2064, M. C. Z., Florissant, Col. (No. 3812, S. H. Scudder Coll.).

It is of course impossible to be definite regarding the systematic position of a fossil gall, or even to be perfectly sure that the specimen is an insect gall. However, under a magnification of about forty diameters the concentric arrangement of tissue remaining about the periphery of the cicatrix leaves little doubt that the large central ovoid area which has now flaked off the rock represents an insect gall. Its size and position on the leaf suggest the cynipid Andricus. In connection with this it is interesting to note that there are in the collection a few insects which are quite probably referable to the recent genus Andricus, most of the living species of which are believed to form galls on various species of Quercus. So far as I can ascertain no galls on Myrica produced by recent species have been described. We can never hope to associate fossil gall-flies with their habitations in a specific way, and it seems justifiable therefore, to give the present gall a specific name.

IBALIINAE.

PROTOIBALIA, gen. nov.

Head and thorax coarsely sculptured, the abdomen shining, but little longer than the head and thorax together. Ovipositor prominent, at least longer than the abdomen and probably much longer as the tip is not preserved in the type specimen. Antennae of the female filiform, apparently 13-jointed, the apical flagellar joints shorter than the basal ones. Metathorax short, truncate; scutellum unarmed. Abdomen sessile, elongate oval. Legs moderately stout, the posterior femur broad, but nearly as long as its tibia. Hind metatarsus apparently equal in length to the following taken together. Wings with the radial cell much shorter and broader than in Ibalia; three submarginal cells, the first large and indistinctly closed below, second very small, third open.

A most remarkable genus which combines characters of Ibalia and certain true cynipines. In habitus it is somewhat suggestive of Leucospis, in fact after a preliminary examination of the reverse which does not show the wing, I had labeled it "related to Leucospis?"

Type.— P. connexiva, sp. nov.

PROTOIBALIA CONNEXIVA, sp. nov. (Fig. 8.)

Female. Length 5 mm. Yellow, varied with black. Antennae brownish, legs basally and the posterior pair almost entirely dark; abdomen with the segments dark below and apically. Head rugose punctate; antennae slender, of equal thickness throughout, except for the swollen scape. Pedicel less than one-half as long as the first flagellar joint which is about four times as long as thick; second longer than the first; following growing shorter. Thorax roughly sculptured, the mesonotum transversely rugose; propleurae irregularly so. Metathorax and probably also the scutellum rugose. Abdomen apparently with five segments of approximately equal length, the first two somewhat shorter. Wings hyaline, the veins brown.

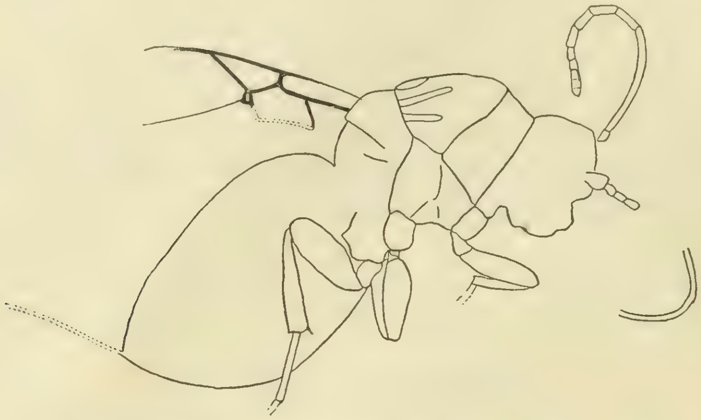

Fig. 8.— Protoibalia connexiva, gen. et sp. nov. Type.

Type.— No. 2065, M. C. Z., Florissant, Col. (No. 13,514, S. H. Scudder Coll.). Also the reverse, No. 2066 M. C. Z., Florissant, Col. (No. 13897, S. H. Scudder Coll.).

AGAONIDAE.

The occurrence of what is undoubtedly a true fig insect among the specimens from Florissant is one of the most interesting discoveries which I have made.

The presence of fossil fig trees in the Florissant flora is already known, and the occurrence of a fig insect shows that they were undoubtedly then fertilized through the agency of Agaonidae just as they are at the present day.

Tetrapus mayri, sp. nov. (Fig. 9.)

Female. Length 4 mm. Probably dark colored, although nearly all the color indications are flaked off in the type. Head preserved in lateral view; very long, proclinate, fully twice as long as thick. Antennae apparently 11-jointed, rather stout, the scape short, pedicel small, flagellum not thickened apically, first three joints about quadrate; following also apparently about the same shape, the last probably longer. Thorax above and on the pleurae coarsely sculptured, transversely rugose-striate, merely striate or aciculate on the pleurae anteriorly. Thorax strongly arched above, the metathorax long, with some transverse irregular areas anteriorly. Spiracles very large and prominent, oval. Abdomen only two-thirds as long as the thorax, seen laterally it is suddenly truncate apically (the tip missing ?). Ovipositor exserted, but broken away near the base in the type. Anterior and posterior legs very strong and swollen, their coxae large, triquetrous. Middle legs small or wanting, at least not indicated in the specimen, although the anterior and posterior pairs are very well preserved and quite prominent. Wings hyaline, venation not distinguishable.

Described from one specimen.

Type.— No. 2067, M. C. Z., Florissant, Col. (No. 13,976, S. H. Scudder Coll.). It is not very well preserved in certain parts, but most interesting as the only known fossil belonging to the group of fig insects. It is also a representative of a family at present confined to the tropical and semitropical regions of both hemispheres, and thus shows a distinct southern element in the Florissant insect fauna.

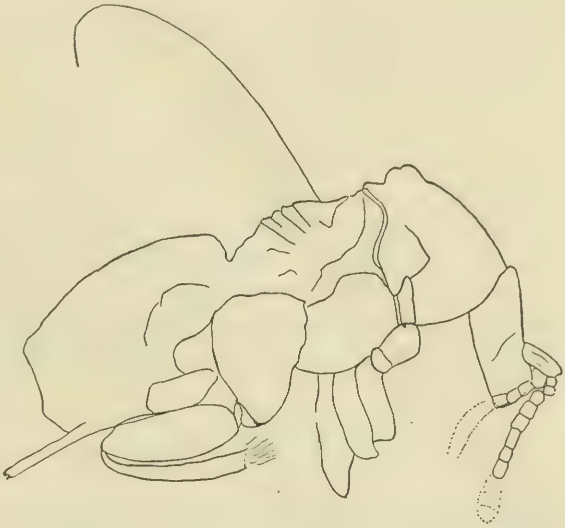

FIG. 9.— Tetrapus mayri, sp. nov. Type.

The genus Tetrapus Mayr to which I have referred it occurs at the present time in Brazil where it is represented by a single species, *T. americanus*, described by the late Dr. Gustav Mayr, a well-known authority on fig insects in whose memory I take a very great pleasure in dedicating the fossil form.

TOYRMIDAE.

The presence of a species of Torymus in the Middle Oligocene of Brunstatt in Alsatia has been noted by Förster (**'91**), but no other fossil members of this family have been previously made known. The Florissant material contains three genera, one of them new, representing in all six species.

TORYMUS SACKENI, sp. nov. (Fig. 10.)

Female. Length 9 mm. Ovipositor nearly as long as the body. Stout, robust, black, the abdomen brownish or reddish yellow. Head finely striated, obliquely so on the lower part, and vertically so above. Entire upper side of thorax and scutellum closely and finely transversely aciculate, the aciculations arranged in coarse transverse rugae. Abdomen elliptic, broad when seen in lateral aspect. Ovipositor stout, curving upward, issuing from the tip of the abdomen, but visible as an impression in the specimen to the base of the abdomen where it curves upward to the middle of the basal part of the abdomen. Wings and legs not preserved.

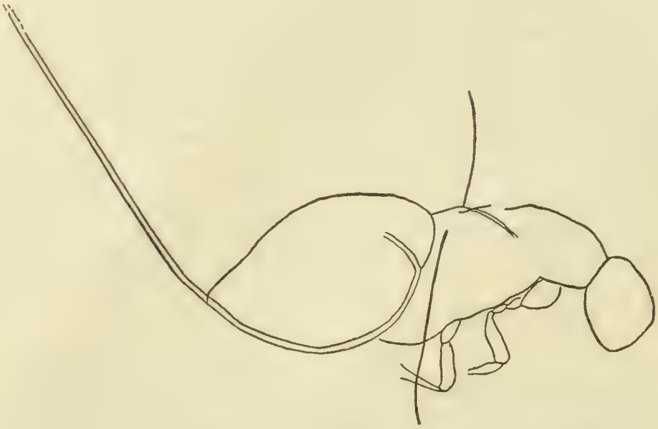

Fig. 10.— Torymus sackenii, sp. nov. Type.

Type.— No. 2068, M. C. Z., Florissant, Col. (No. 12,869, S. H. Scudder Coll.).

This may be a Palaeotorymus but its large size and stout habitus recall so strongly the North American *T. magnificus* O. S. that I have ventured in the absence of the wing to place it in the recent genus.

PALAEOTORYMUS, gen. nov.

General habitus like that of Torymus and its allies, but easily distinguishable by the immensely elongated postmarginal vein which extends nearly to the apex of the wing. In recent Torymidae the postmarginal vein is generally distinctly developed, but in no case does it approach this extraordinary length.

Type.— *P. typicus*, sp. nov.

Key to the Florissant species of Palaeotorymus.

1. Thorax transversely aciculated . . . . 2.
   Thorax smooth, anteriorly more or less distinctly transversely rugulose . . . . *P. laevis*, sp. nov.

2. Sculpture of thorax fine and delicate . . . . 3.
Sculpture of thorax coarse . . . . . . *P. striatus,* sp. nov.
3. Marginal vein short, only twice as long as the stigmal.
P. aciculatus, sp. nov.
4. Marginal vein long, much more than twice as long as the stigmal.
P. typicus, sp. nov.

PALAEOTORYMUS TYPICUS, sp. nov. (Fig. 11.)

Female. Length 3–5.5 mm. Color black, the abdomen fuscous. Probably in life the color was metallic green with a yellowish brown abdomen. Wings hyaline, the veins fuscous. Antennae dark colored, the joints toward the middle of the flagellum a little longer than wide, becoming transverse nearer the apex; they are thickest at about the sixth flagellar joint. Head behind rather finely vertically striate or aciculate; thoracic dorsum also finely transversely striate, the striations extending down over the greater part of the pleurae. Metathorax and metapleurae smooth. Legs rather slender; the tibiae and tarsi light colored, except the base of the hind tibiae. Hind coxae outwardly transversely striate. Abdomen about as long as the head and thorax together, flat below and convex above, its surface smooth and polished. Ovipositor a little longer than the abdomen. Marginal vein long, stigmal knobbed, with a distinct pedicel, oblique; postmarginal very long, extending well toward the apex of the wing, or at least indicated by a dark streak resembling a vein that is very distinct.

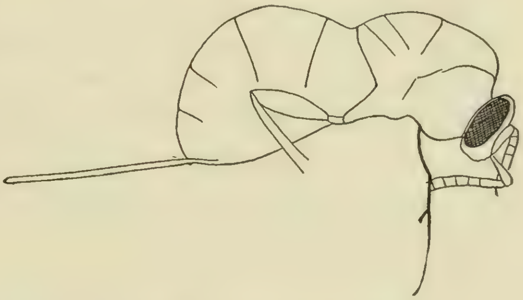

FIG. 11.— Palaeotorymus typicus, sp. nov. Type.

Type.— No. 2072 M. C. Z., Florissant, Col. (No. 610, S. H. Scudder Coll.). Described from fourteen specimens, all in the Collection of the M. C. Z., Nos. 2072–2082, 2195–2198, S. H. Scudder collection, Nos. 610, 997, 2145, 4873, 4511, 4891, 5511, 6164, 6250, reverse of 6164, 7395, 8358, 8917, 10,032, 10,884, 13,354).

The long postmarginal vein of this species is remarkable and is shared also by the following species. There seems to be no doubt, however, that they are close relatives of recent Toryminae in spite of the peculiar development of this vein, and the long stigmal vein which resembles that of the Idarninae.

PALAEOTORYMUS LAEVIS, sp. nov.

Female. Length 4–5 mm. Body shining and rather stout, with the abdomen probably as dark in color as the head and thorax. Surface of head almost smooth. Antennae stout, the flagellum of almost even thickness, slightly stouter near the center where the joints are distinctly wider than long. Thorax smooth except for a sparse coarse rugoso-punctate sculpture on the prothorax, anterior part of mesonotum and the anterior part of the pleurae. The thoracic sutures are deep and slightly crenulate. Abdomen stout, probably considerably compressed, its surface smooth. Ovipositor not entirely preserved, but more than half as long as the abdomen. Posterior coxae weakly and irregularly punctate-striate above; legs slender. Wings with a rather short marginal vein, the stigmal well developed and knobbed, one-third the length of the marginal. Postmarginal vein at least one and one-half times as long as the stigmal and probably longer, but its tip is obscured.

Described from one specimen.

Type.— No. 2083, M. C. Z., Florissant, Col. (No. 9655, S. H. Scudder Coll.).

This is quite similar to the preceding, but the thorax is smooth except for some rough sculpture anteriorly. A second specimen, later sent by Professor Cockerell collected at Station 17B appears to belong to the same species.

PALAEOTORYMUS STRIATUS, sp. nov.

Female. Length 5 mm. Dark colored, probably metallic green, including the entire legs. Head poorly preserved, its surface finely aciculate or shagreened; median joints of antennal flagellum distinctly wider than long. Entire thorax coarsely sculptured; prothorax transversely striate; mesonotum irregularly transversely punctato-striate, the striae curving posteriorly as they extend down on to the upper part of the pleurae. Mesopleura deeply confluently punctate. Metathorax obscured, but apparently smooth with a few coarse reticulations. Abdomen short, ovate in lateral view. Ovipositor exposed only at the base, but I think it can be seen as a trace through the stone for a distance greater than the length of the abdomen. Legs very stout, but this may be due in part to pressure. Wings strong, the veins piceous. Stigmal vein long, knobbed; two-fifths as long as the marginal; postmarginal stout for a distance twice the length of the stigmal, then continued less distinctly nearly to the wing tip.

One very well preserved specimen.

Type.— No. 2084, M. C. Z., Florissant, Col. (No. 10,315, S. H. Scudder Coll.).

A deeply colored, stout species, the thorax much more strongly sculptured than in the two preceding ones.

PALAEOTORYMUS ACICULATUS, sp. nov. (Fig. 12.)

Female. Length 4 mm. Probably entirely metallic green, although there are traces of ferruginous or brown on the abdomen. Thorax finely sculptured. Head behind vertically aciculate on the sides and transversely so on the occiput. Pro- and mesonotum very finely transversely aciculated. Pleurae also coarsely aciculated, but not regularly so except in patches. Base of metathorax on the sides longitudinally aciculated, the remainder of the metathorax irregularly coarsely sculptured. Ovipositor extruded, preserved for only a short distance. Wings hyaline, the veins brown. Marginal vein short, not more than one-half the length of the submarginal, the stigmal more than half as long as the marginal, and but indistinctly knobbed. Postmarginal long as usual in the genus.

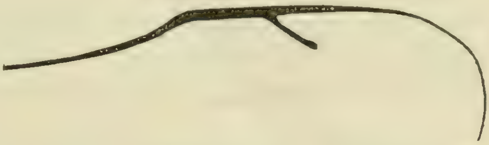

FIG. 12.— Palaeotorymus aciculatus, sp. nov. Type.

Type.— No. 2085 M. C. Z., Florissant, Col. (No. 2065, S. H. Scudder Coll.).

This species resembles *P. typicus*, but differs by its much shorter marginal vein as well as in thoracic sculpture. Unfortunately the tip of the ovipositor has been scraped away in cleaning the specimen.

ORMYRODES PETREFACTUS, sp. nov. (Fig. 13.)

Female. Length more than 11 mm. Black, slender, tapering, the abdomen two and one-half times as long as the head and thorax together. Head large, appearing more or less globose. Thorax long, oval, nearly three times as

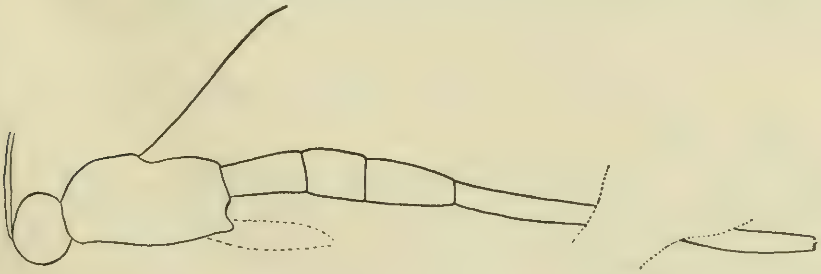

FIG. 13.— Ormyrodes petrefactus, sp. nov. Type.

long as high; its surface sculpture not well preserved. Hind coxae projecting in a raised line above. Antennae poorly preserved, long, reaching nearly to the base of the wings. Metathorax transversely rugose, as long as the mesonotum and nearly two times as long as the prothorax which is contracted in front. Abdomen long and tapering, inserted well up toward the top of the metathorax on its posterior slope, but I think this is due to a slight twisting of the body out of its lateral position. Basal segment as long, but not quite as wide as the second and somewhat narrowed basally; third narrower, and longer, tapering to the tip; the remainder of the abdomen strongly produced into a stylus-like tip which is at least one and one-half times as long as the three basal segments and probably longer as the apex is not preserved. Legs slender; brown, except the posterior coxae. Wings hyaline, not well preserved, but apparently with a long marginal and minute stigmal vein.

Described from one specimen.

Type.— No. 2086, M. C. Z., Florissant, Col. (No. 5657, S. H. Scudder Coll.).

This is one of the most remarkable chalcids I have ever seen. Unfortunately the parts are poorly preserved although the specimen is very sharp and distinct when viewed without magnification. However I feel well assured of its position here on account of its close similarity both in size and habitus to the recent genus Ormyrodes Brues of which only a single recent species, occurring in South Africa, has so far been discovered. In the fossil form the abdomen is even more attenuated. Certain eurytomids like Macrorileya and its allies are very similar in form, but I hardly think the present species can belong in that family.

CHALCIDIDAE.

Chalcites debilis Heer probably belongs here, otherwise no fossil forms of this family are known, except from Florissant. Professor Cockerell has already published a description of one species of Chalcis to which I have two others to add and also one Spilochalcis.

Key to the Florissant species of Chalcis.

1. Wings hyaline . . . . 2.
   Wings with a broad brownish band, abdomen two and one-half or three times as long as wide . . *C. praevalens* Cockerell.
2. Scapulae, pronotum, and sides of mesonotum distinctly transversely striate in sculpture . . . . . . *C. tortilis*, sp. nov.
   Entire thorax irregularly coarsely punctate, only the anterior half of the sides of the mesonotum with traces of striate sculpture. *C. perdita*, sp. nov.

CHALCIS PRAEVALENS Cockerell.

There are two specimens of this species in the present collection M. C. Z., No. 2087, 2088 (Nos. 5279, 7939, S. H. Scudder Coll.).

CHALCIS TORTILIS, sp. nov. (Fig. 14.)

Length 4.5–7 mm. Head and thorax very coarsely and deeply separately punctate, the sculpture on the collar less deep, and confluent to form a transverse series of rather regular striations. The parapsides especially toward the sides show the same transverse striation. Punctures on the scutellum larger and better separated than elsewhere. Mesonotum quite regularly reticulate. Abdomen smooth, ovate; narrow, only about two-thirds as wide as the thorax. Head as usual in the genus, probably black; sides of the front obliquely striate. Antennae black; rather slender, the scape about half as long as the flagellum; basal flagellar joints about twice as long as thick. Parapsidal furrows very distinct, twice as far apart in front as behind. Scutellum about as wide as long, regularly rounded behind. Hind femora about twice as long as broad, beset below with rather small teeth, of a size and number very similar to those of the recent *C. ovata* Say. Hind tibiae stout, their curve conforming with that of the femur. Wings hyaline or nearly so. Marginal vein one-half the length of the submarginal. Stigmal long, its shaft at least twice as long as the width of the marginal vein at its insertion, knobbed at the apex. Postmarginal about one-half the length of the marginal.

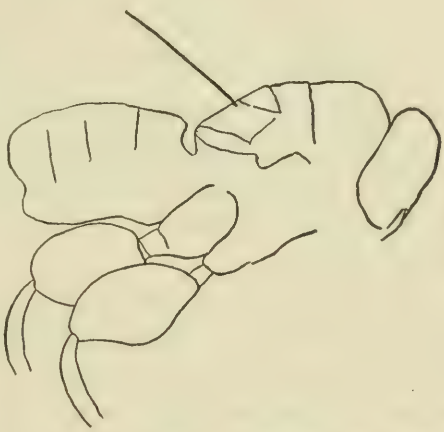

FIG. 14.— Chalcis tortilis, sp. nov. Type.

Described from four specimens.

Type.— No. 2089, M. C. Z., Florissant, Col. (No. 1350, S. H. Scudder Coll.). Paratypes Nos. 2090–2092. Nos. 1065, 3538, and 5295, S. H. Scudder collection. In addition to these there is another (No. 2093, M. C. Z., No. 5672 S. H. Scudder Coll.) which is probably a ventral view of this species and also a side view (No. 2094 M. C. Z., No. 7679 S. H. Scudder Coll.) which seems without much doubt to belong here.

Chalcis perdita, sp. nov.

Length 4–7.5 mm. Head and thorax with coarse thimble-like punctures which do not merge into striations on the pro- and mesothorax; the punctures largest on the scutellum and the upper part of the mesonotum. Body presumably dark or black with the tarsi, venter of abdomen, and posterior margins of abdominal segments reddish or rufous. Antennae dark brown, black basally, the joints near the middle of the flagellum wider than long. Scutellum raised anteriorly and sloping back, projecting laterally over the metapleurae. Metanotum rather regularly hexagonally reticulate, its lower hind angles laterally produced. Abdomen as long as the head and thorax, smooth, shaped as in *C. ovata* Say. Posterior femora very broad, almost as wide as long, with about eight moderately large teeth toward the apex, the tibiae evenly arcuated. Wings hyaline, marginal vein about two-thirds the length of the submarginal; stigmal short and oblique, about twice as long as the thickness of the marginal vein, and not or imperceptibly enlarged at the tip.

Described from three specimens.

Type.— No. 2095 M. C. Z., Florissant, Col. (No. 4801, S. H. Scudder Coll.). Paratypes, Nos. 2096–2097, M. C. Z.(Nos. 7817 and 9547, S. H. Scudder Coll.). All are seen nearly in profile in much the same position.

No. A76 and reverse in the collection of the American Museum of Natural History collected by Professor Cockerell at Station 13 appear to be this species, but are seen in dorsal view with the wings not preserved. The punctures on the head above are elliptical and more or less confluent.

Spilochalcis scudderi, sp. nov.

Length 5.5 mm. A specimen seen in ventral aspect, with the head bent down. Inner margins of eyes parallel, the front coarsely punctate, with an oval smooth space centrally which shows microscopic circular aciculations. Antennae 13-jointed, distinctly clavate, the scape a little more than half as long as the flagellum. Joints beyond the middle of the flagellum one-half wider than long. The antennae are inserted just about on an imaginary line drawn between the lower margins of the eyes. Sides of face below obliquely striated, cheeks smooth. Projecting sides of metanotum below irregularly reticulated, the lateral angles angularly produced. Posterior coxae more than half as long as the femora, slender and about twice as long as the abdominal petiole. Posterior femora oval, somewhat less than twice as long as broad. Abdomen rounded at the tip, distinctly longer than the thorax.

Described from one specimen, seen in ventral aspect. The antennae are inserted much lower than is usual in Spilochalcis and its allies and it is barely possible that this insect is really a member of the Chalcitellini.

Type.— No. 2098, M. C. Z., Florissant, Col. (No. 9136, S. H. Scudder Coll.).

EURYTOMIDAE.

Decatoma has been recorded by Scudder ('78) from the Oligocene of Green River, Wyoming, but otherwise I can find no palaeontological reference to the group. The present collection contains two species of Eurytoma.

EURYTOMA SEPULTA, sp. nov. (Fig. 15.)

Female. Length 4.5 mm. Black or very dark, including legs and antennae; wings hyaline. Antennae apparently 13-jointed, with one ring joint, the last three joints forming a slight, but quite distinct club; funicle joints about quadrate. Surface of head irregularly rugulose. Dorsum of thorax strongly transversely rugoso-punctate. Abdomen quite distinctly sessile, ovate in lateral aspect, the last ventral segment acutely prolonged. Wings hyaline, venation fuscous; marginal vein long, about two and one-half times the length of the stigmal. Stigmal weakly divergent from the postmarginal, strongly knobbed; postmarginal much longer than the stigmal, stout.

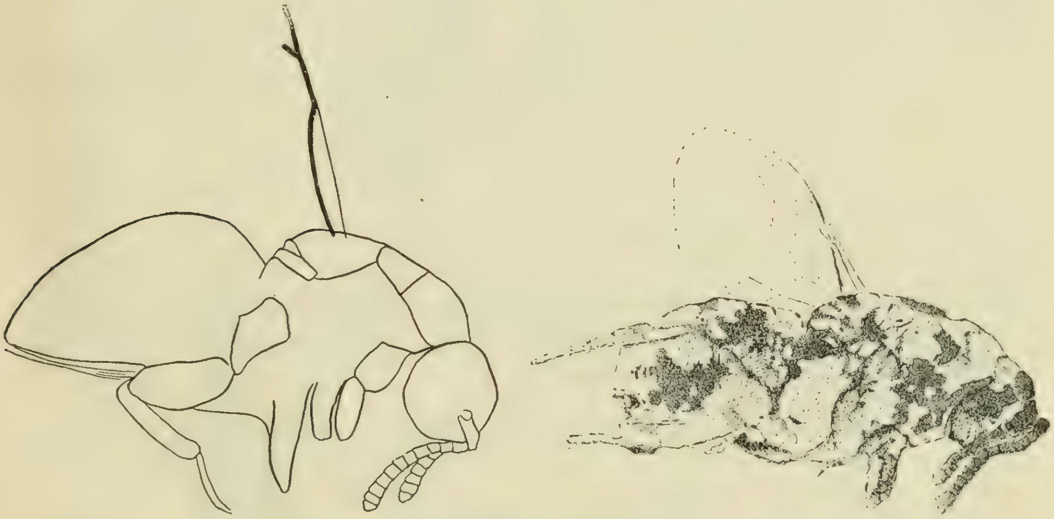

FIG. 15.— Eurytoma sepulta, sp. nov. Type.

Described from three specimens, No. A9 (type), A103 both from

Station 14 and No. 2100, M. C. Z., Florissant, Col. (No. 9065, S. H. Scudder coll.).

Type in the Amer. Mus. Nat. Hist.

The arrangement of the large umbilicate punctures on the thorax of this species is more regularly transverse than in recent forms and the antennae more distinctly clavate than in the majority of living species, but otherwise this seems to be quite a typical representative of the group.

EURYTOMA SEQUAX, sp. nov. (Fig. 16.)

Male. Length 3.75 mm. Represented by a poorly preserved specimen, but so characteristic that it is undoubtedly an Eurytoma or a Decatoma. The body is black, with a small brownish abdomen. The legs, wings, and antennae are not preserved. One might perhaps associate it with the preceding species, but the large thoracic punctures are less closely placed and show no tendency to assume a transverse arrangement.

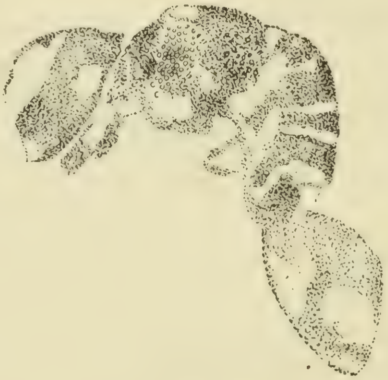

FIG. 16.—Eurytoma sequax, sp. nov. Type.

No. A120, collected at Station 14. Type in the Amer. Mus. Nat. Hist.

PERILAMPIDAE.

Brischke ('86) has found Perilampus in Baltic Amber.

CLEONYMIDAE.

The following species is the first fossil member of the family to be described.

Cleonymus submersus, sp. nov. (Fig. 17.)

Female. Length 7 mm. Entirely black, with slightly infuscated wings. Head as seen from above rounded in outline, narrower than the thorax which is elongate, two and one-half times as long as wide. Abdomen elongate, conic ovate, its segments, except possibly the basal two, of nearly equal length. Wings very thickly pubescent, with stout dark venation; marginal vein long, one-half the length of the submarginal; stigmal short and stout, thicker at the apex, postmarginal as long as the marginal, but attenuated beyond its basal part.

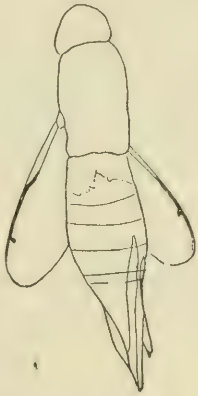
Fig. 17.— Cleonymus submersus, sp. nov. Type.

Type.— No. 2101, M. C. Z., Florissant, Col. (No. 9109, S. H. Scudder Coll.).

This is not a very well preserved specimen, but is striking on account of its large size and acuminate abdomen.

PTEROMALIDAE.

Aside from Heer's ('65), doubtful genus Pteromalinites Helm ('99) has recorded Pteromalus from Amber, but without description or figure. I have one species of Pteromalus from Florissant.

Pteromalus exanimis, sp. nov. (Fig. 18.)

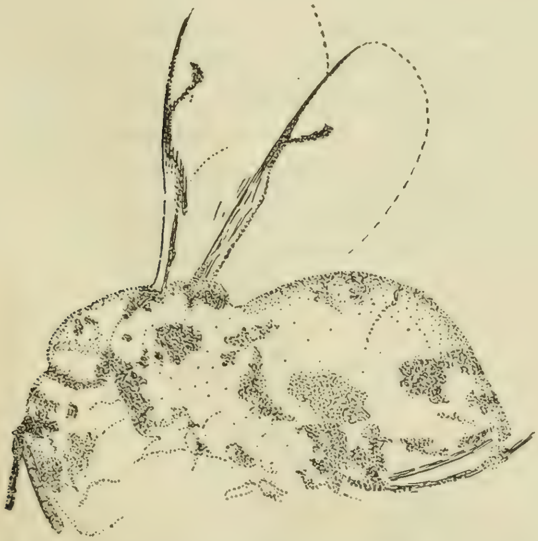
Fig. 18.— Pteromalus exanimis, sp. nov. Type.

Female. Length 3–3.5 mm. Black (metallic in life?) with hyaline wings and piceous or brownish abdomen. Propleurae finely transversely rugose, the mesonotum smooth, with a few delicate punctures, indistinctly rugose on the pleurae. Metathorax short, with carinae indicating some areas. Abdomen sessile, ovate, pointed apically; third segment the longest, following gradually shorter, the second a little shorter than the third. Wings pubescent, the marginal vein short and thick; one-sixth, or perhaps less, the length of the submarginal; stigmal broadly divergent, strongly hooked at the tip and nearly as long as the marginal. Postmarginal strongly developed, one and two-thirds times as long as the marginal. Ovipositor not or but little exserted.

Two specimens, one of them with reverse. Type and its reverse Nos. A57 and A55 from Station 13; A34 from Station 17, in the Amer. Mus. Nat. Hist.

Although not very well preserved this appears to be a common species and deserving of a name. There are a number of other specimens which are quite probably the same, but such minute fossils are very difficult of specific association. The term Pteromalus is used in the wide sense.

MYMARIDAE.

This family is abundantly represented both in Amber and Copal, but has not been found fossil elsewhere. The extremely minute size and fragile character of the species would make their recognition in shales like those of Florissant, very difficult.

The Amber species found are listed on page 111.

EVANIIDAE.

Up to the present time there are two references in palaeontological literature to fossil Evaniidae. Burmeister (**'31**) records the occurrence of Evania in Baltic Amber, and Brischke has later (**'86**) mentioned a species belonging to one of the closely related genera, quite probably the same genus under the name of Brachygaster, from the same source.

In the present material I have discovered two finely preserved species belonging to the Aulacinae, so that of the three subfamilies, Aulacinae, Foeninae, and Evaniinae at present recognized, only the second is unknown in the fossil state.

AULACUS BRADLEYI, sp. nov. (Fig. 19.)

Length probably about 18 mm., the abdomen missing. Entirely dark or black, the legs somewhat lighter beyond the knees. Head seen from the front three-fourths as broad as high, gradually narrowed and rounded below; its surface minutely punctate or shagreened. Antennae inserted close together near the clypeus. Antennae much like those of recent species, the joints of the antennal flagellum beyond the first long and cylindrical. Thorax typically transversely channeled or ribbed, the parapsidal furrows distinct. Scutellum less coarsely sculptured, transversely rugose. Metanotum rather finely, irregularly reticulated. Abdomen not visible, but its insertion on the dorsal tubercle of the metanotum is indicated, and the abdomen due to its elevated position is no doubt concealed in the matrix. Legs normal so far as preserved, the posterior coxae transversely granulated above. Wings hyaline, with fuscous stigma and veins. Subcostal cell very broad and distinct, but very slightly pigmented. Stigma small, elongate ovate. Radial cell long and of even width on the basal half; the second section of the radius nearly as long as the third and twice the length of the first. First cubital and first discoidal cells nearly equal along the base, the discoidal slightly the higher; first recurrent nervure received by the second cubital cell near its base; only two closed cubital cells, the second very distinctly closed; second recurrent nervure received considerably beyond the middle of the second cubital cell. Median and submedian cells of equal length; subdiscoidal nervure broken slightly below the middle.

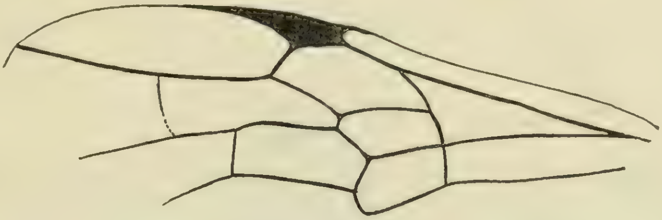

FIG. 19.— Aulacus bradleyi, sp. nov. Type.

One specimen and reverse, Nos. B1 and B2 collected by Mrs. Cockerell at Station 13b during 1908. Named for my friend Mr. J. Chester Bradley in recognition of his extensive studies in this interesting family.

This is a large and beautifully preserved species which resembles typical recent species except that the first recurrent nervure is inserted very distinctly at the base of the second cubital cell instead of being interstitial or received near the tip of the first. However, I hardly think it worthy of generic rank on this single character in the absence of any other preserved ones which I can discover.

PRISTAULACUS ROHWERI, sp. nov. (Fig. 20.)

Female. Length 7 mm. Ovipositor at least two-thirds the length of the abdomen and probably longer. Black or very dark, with the abdomen except the tip much lighter, reddish or brown. Legs apparently light colored. Surface of head finely shagreened, with faint traces of a microscopic transverse aciculation above; antennae not well preserved in the type, one of the joints (probably the third) very long. Prothorax very strongly and coarsely transversely striate, the ridges between the grooves sharp, well elevated; mesopleurae also coarsely obliquely striate; metanotum more or less distinctly areolated and irregularly rugose. Abdomen inserted at the upper edge of the posterior slope, about as in *P. occidentalis* Cress., but the abdomen appears to be much shorter and stouter than in that species, although this may be due to compression in the stone. The petiole appears to be short, but little longer than the second segment; third to fifth somewhat shorter, subequal. Ovipositor visible for about two-thirds the length of the abdomen where its tip is lost in the stone. Wings hyaline except for a very distinct infuscated spot below the stigma. Veins and stigma pale brown; first recurrent nervure received at three-fourths the distance from the base to the apex of the first cubital cell; first discoidal cell very small for this genus, its base scarcely over one-fourth the length of the basal vein, its upper side nearly three times as long as its base along the basal vein; second discoidal very high and short. Second transverse cubitus present, distinct, the second recurrent nervure inserted at the apical one-fourth of the second cubital cell. Marginal cell short, not more than two and one-fourth times as long as wide.

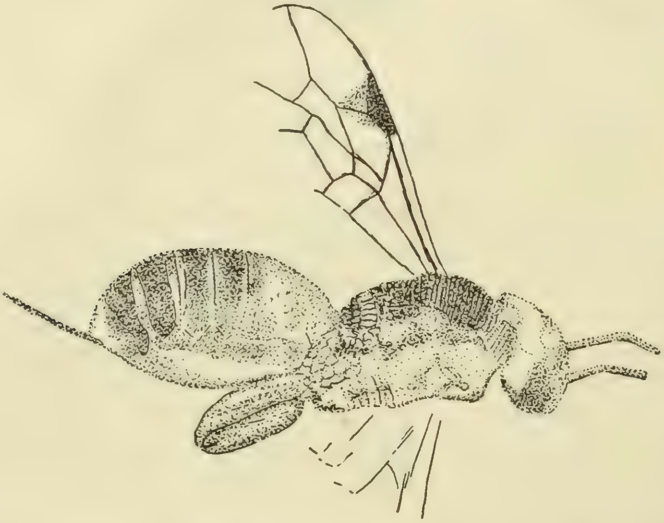

FIG. 20.— Pristaulacus rohweri, sp. nov. Type.

One specimen, collected by Mr. S. A. Rohwer at Station 14; very nicely preserved.

This is a very interesting species which seems to fit tolerably well in this genus. The stigmal spot which is very distinct in both wings recalls at once the recent *P. occidentalis* Cresson which it also resembles in many other characters. However, the first cubital and the marginal cell are considerably longer, and the discoidal smaller and more elongate. This cell appears to be smaller than in any living species of Aulacus or allied genera with which I am familiar and suggests a relationship to Foenus (Gasteruption) in which this cell is very small. It would appear therefore that the present form may have been related to some of the transition forms between Foenus and the more generalized Evaniidae.

ICHNEUMONIDAE.

ICHNEUMONINAE.

Only one species, a Trogus, is contained in the collections from Florissant. Heer ('67) has described as *Ichneumonites fusiformis* a species which he thought probably a Trogus, but which from its sessile abdomen and long ovipositor is evidently a pimpline.

TROGUS VETUS, sp. nov. (Fig. 21.)

Probably a female. Length about 15 mm. Black, the abdomen pale brown with transverse black bands. Wings hyaline. Rather stout, head large and broadly transverse; antennae preserved only at the extreme base where they are rather slender. Face and front black, with a central pale yellowish brown spot above the insertion of the antennae. Mesonotum smooth or very finely shagreened; scutellum convexly elevated, with a depression at its base that is margined by a raised line on each side which does not extend to the raised portion. Metanotum partially areolated, there being a single large lateral area on each side separated from the single median one. Abdominal petiole black, the postpetiole margined narrowly behind with dull yellow or pale brown. Postpetiole finely punctate, the extreme tip rugose; second segment pale brown, with a transverse quadrangular black spot medially; third with a much smaller, more nearly round dark spot; fourth with a

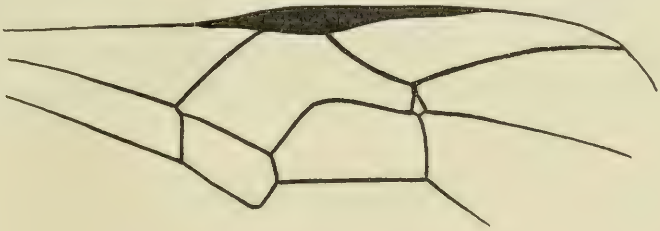

FIG. 21.— Trogus vetus, sp. nov. Type.

similar very small one at its base. Wings hyaline, the veins fuscous or piceous; stigma narrowly lanceolate, dark brown, white at the base. Submedian cell in anterior wing distinctly longer than the median, cubitodiscoidal vein with no stump of a vein; areolet very small, subrhomboidal or nearly triangular, with a long petiole above; receiving the recurrent nervure at its middle. Transverse median vein in hind wing broken at the middle.

Type.— No. 2102, M. C. Z., Florissant, Col. (No. 74, S. H. Scudder Coll.).

One specimen, seen in dorsal view. This has the general habitus of a species of Ichneumon, but the ill-defined carinae of the metanotum and the peculiar subrhomboidal areolet in the wing place it rather definitely as a species of Trogus or of some closely related genus.

All of the species from Florissant that I have satisfactorily referred to the Ichneumonini belong to the genus Ichneumon. Amblyteles has been found by Schöberlin ('88) in the Upper Miocene of Oeningen.

In addition to these there is a record by Brischke ('86) noting the occurrence of Ichneumon in Baltic Amber, and many others referring to the same genus, but most of these are made in such a vague and unsatisfactory way that they can be considered as little more than the use of the term Ichneumon to designate any member of the Ichneumonidae. The following, however, can be more definitely placed:—

Ichneumon infernalis Heer ('65) on account of its elongate ovipositor is probably a cryptine.

Ichneumon longaevus Heer ('49) is apparently a true Ichneumon.

Ichneumon petrinus Scudder ('90) to judge from the excellent figure is a braconid belonging to the Spathiinae. The discoidal and first cubital cells are separated only apically according to the description, but the basal part of the cubitus has most likely been lost. The form of the head and thorax particularly are exactly similar to Hormiopterus and its allies.

ICHNEUMON Linné.

This genus is represented in the material at hand by ten species, many of them referable with some certainty to some of the subgenera established for recent forms of this very extensive group. One peculiarity exhibited by a number of the fossil species is the shortening of the upper or radial side of the areolet. This gives the wing a peculiar appearance, but is I think of secondary importance as these species agree otherwise with genuine species of Ichneumon.

Key to the Florissant species of Ichneumon.

1. Small, 6 mm. in length; areola of metanotum very small, nearly semicircular; antennae slender, all the joints much longer than wide; wings hyaline . . . . *I. alpha*, sp. nov.
Larger species, 8–15 mm. in length . . . . 2.
2. Wings hyaline, *i. e.* not or scarcely darker than the stone . 3.
Wings infuscated, much darker in color than the stone . . 8.
3. Very large, 19–21 mm. in length . . . . . *I. pollens*, sp. nov.
Small or moderate in size, less than 15 mm. . . . . . 4.
4. Second section of the radius nearly three times as long as the first (70 : 25) . . . . *I. obduratus*, sp. nov.
Second section of the radius approximately twice as long as the first . . . . *I. primigenius*, sp. nov.
Second section of the radius one-half longer than the first 5.
5. Discocubital vein with a stump of a vein near its centre . 6.
Discocubital vein simple, without any trace of a stump of a vein.
I. decrepitus, sp. nov.
6. Slender species, basal joints of antennal flagellum four or five times as long as thick . . . . 7.
Stout species; basal flagellar joints not more than three times as long as thick; abdomen not conspicuously banded.
I. exesus, sp. nov.
7. Areolet large, regularly pentangular . . *I. torpefactus*, sp. nov.
Areolet moderate, its radial side much shortened
I. provectus, sp. nov.
Areolet small, regularly pentangular *I. cannoni* Cockerell, sp. nov.
8. Large species, 15–18 mm. . . . . . . *I. dormitans*, sp. nov.
Smaller species, 12 mm. or less . . . . 9.
9. Discocubital vein evenly curved; wings fulvous, body in part light colored . . . . *I. concretus*, sp. nov.
Discocubital vein with trace of a stump of a vein; wings blackish, body dark colored . . . . *I. somniatus*, sp. nov.

ICHNEUMON ALPHA, sp. nov.

Probably a male. Length 6.5 mm. Uniformly black or dark, the antennae and part of the legs brown or fuscous. Wings hyaline. Head smooth or microscopically sculptured, its surface opaque, strongly transverse in general shape. Mesonotum subopaque, the parapsidal furrows rather distinctly marked anteriorly by a line of punctate depressions. Scutellum very slightly convex, with a crenulate transverse groove at its base and raised lateral margins. Metathorax fully areolated; areola of metanotum very small and almost semicircular; basal and middle lateral areas complete and separated. Abdomen subopaque, the sculpture of the postpetiole so delicate as to be scarcely visible in the specimen. Abdomen rather short and broad, sharply narrowed on its apical portion. Legs scarcely preserved, the hind femora black and the tibiae of the hind legs dark basally with lighter apex and brown tarsi which are weakly annulated with paler. Antennae long and slender, flagellar joints two to four fully twice as long as thick; apical joints shorter, but still longer than thick. Wings hyaline, the veins pale fuscous. Submedian cell in front wings considerably longer than the median, the transverse median nervure very oblique; discocubital vein evenly curved and without a stump of a vein; areolet very narrow above, its side on the radial vein being very short. Marginal cell long, the second section of the radius three times as long as the first.

Type.— No. 2103, M. C. Z., Florissant, Col. (No. 10,955, S. H. Scudder Coll.).

This is a small species which seems to be referable to Thomson's subgenus Barichneumon, particularly on account of the configuration of the metanotal areolae and comparatively stout antennae.

ICHNEUMON POLLENS, sp. nov. (Fig. 22.)

Length 19–21 mm. Large and robust, dark colored, with the abdomen apparently more brownish and more or less distinctly banded with black on the basal segments anteriorly. Wings slightly infuscated. Antennae short and stout, strongly narrowed apically and involute, the basal joints from one to one and one-half times as long as thick. Head thick, globular when seen from above and probably rather short behind the eyes. Scutellum with the usual laterally keeled depression at the base and with the convex posterior part apparently divided into three parts by two longitudinal impressed lines. Metathorax with very large basal areola and apparently completely areolated on the sides. Abdomen rather slender, the petiole not broadly dilated at the apex; sculpture of the postpetiole indistinguishable. Legs stout. Wings normal, the areolet large and regularly pentangular. Cubitodiscoidal cell very long, almost three times as long diagonally as the length of the basal nervure.

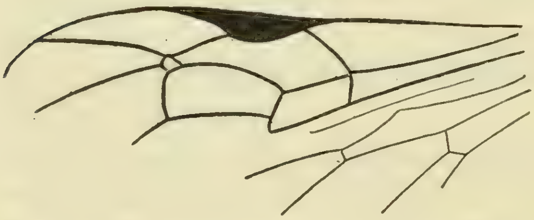

Fig. 22.— Ichneumon pollens, sp. nov. Type.

Described from three specimens and one reverse.

Type.— No. 2104–2105, M. C. Z., Florissant, Col. (No. 13850, reverse No. 14,052, S. H. Scudder Coll. Paratypes Nos. 2106–2107, M. C. Z., (Nos. 6452 and 11,952, S. H. Scudder Coll.).

Two of the specimens are finely preserved, showing the dorsal view of the body, antennae, part of legs, and most of both pairs of wings. It is a very large species and probably belongs to the subgenus Stenichneumon Thomson, to judge from its robust build and thickset, tapering antennae with short joints. The cubito-discoidal cell appears to be somewhat longer in the type specimen, but I think all are undoubtedly the same species. The discocubital vein is without trace of the stump of a vein which is present more or less distinctly in all recent species.

ICHNEUMON OBDURATUS, sp. nov. (Fig. 23.)

Female. Length about 8 mm. Black, legs varied with rufous or ferruginous. Head rather small, more or less subquadrate, its surface subshining. Antennae involute, the basal joints about twice as long as thick and the apical ones more or less quadrate; flagellum apparently without pale annulus. Mesonotum microscopically sculptured, subopaque; parapsidal furrows not defined. Scutellum with a broad transverse depression at its base; its surface moderately convex and with scarcely evident raised lateral margins. Areola of metanotum large, hexagonal, the basal and middle lateral areas separated. Abdomen black, the postpetiole distinctly punctate. Legs rufous or ferruginous, including the coxae. Wings hyaline, veins fuscous, the submedian cell considerably longer than the median, the transverse median vein but little oblique. Discocubital vein evenly and strongly curved, without trace of any stump of a vein. Areolet of moderate size, very narrow above; stigma narrow, black with pale base; marginal cell long, the second section of the radius two and one-half times as long as the first.

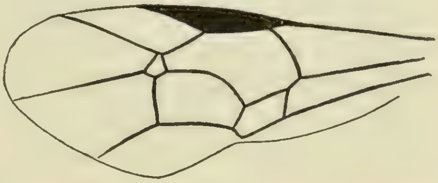

FIG. 23.— Ichneumon obduratus, sp. nov. Type.

Described from one specimen.

Type.— No. 2108, M. C. Z., Florissant, Col. (No. 6691, S. H. Scudder Coll.).

ICHNEUMON PRIMIGENIUS, sp. nov. (Fig. 24.)

Female. Length about 12–13 mm. Body dark, but considerably tinged with brown, especially the thorax and the apical portion of the abdomen.

Legs dark brownish; wings hyaline. Antennae rather long, moderately stout, the basal joints of the flagellum three or four times as long as thick; those near the apex becoming about quadrate; the flagellum apparently not annulated. Mesonotum microscopically punctured; basal and middle lateral areas of metanotum distinctly separated. Postpetiole very finely rugulose or shagreened, subopaque. Wings hyaline, the veins fuscous; marginal cell wide, the first section of the radius being nearly one-half as long as the second. Areolet slightly oblique, large and pentangular, its upper side quite long. Discocubital vein evenly curved and without a trace of a stump of a vein. Stigma rather broad, ovate-lanceolate, fuscous; submedian cell in front wings equal in length to the median.

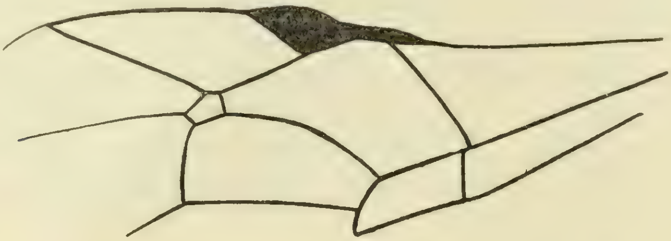

FIG. 24.— Ichneumon primigenius, sp. nov. Type.

Described from one specimen, although there is also a second No. 2110, M. C. Z., Florissant, Col. (No. 2787, S. H. Scudder Coll.) which is doubtfully the same.

Type.— No. 2109, M. C. Z., Florissant, Col. (No. 1680, S. H. Scudder Coll.).

ICHNEUMON DECREPITUS, sp. nov.

Female. Length about 9 mm. Black, the wings hyaline; abdomen with narrow lighter bands on the apices of the segments. Head very strongly transverse; antennae stout, the basal flagellar joints being two times as long as thick and the apical joints transverse. Scutellum rather strongly convex medially and furnished with a broad transverse depression medially which is not margined laterally. Metathorax areolated, but the areas not well preserved in the specimen. Petiole of abdomen strongly dilated and wide at the apex, the postpetiole microscopically sculptured and subopaque; second to fifth segments broad; each with a narrow reddish band along the posterior margin. Legs black, varied with brown on the anterior and middle pairs. Wings hyaline, with the slightest trace of infuscation; stigma and veins dark fuscous. Marginal cell long, but with the first section of the radius fully two-thirds as long as the second. Stigma ovate. Areolet large, pentangular, its upper side long. Discocubital vein evenly curved and without trace of a stump of a vein; submedian cell slightly longer than the median.

Type.— No. 2111, M. C. Z., Florissant, Col. (No. 2085, S. H. Scudder Coll.).

This is a stout, robust species.

ICHNEUMON EXESUS, sp. nov. (Fig. 25.)

Female. Length 13 mm. Yellowish; the head, parts of the thorax and bands on the abdomen black. Head probably entirely black; the antennae brownish yellow, darker basally. Basal joints of flagellum three or four times as long as thick; the apical ones becoming transverse, twice as wide as long; the antennae being moderately stout. Scutellum rather strongly transversely elevated, with a depression at its base which is margined by carinae laterally. Metanotum with the median areola large and quadrate; basal and middle lateral ones separated. Abdomen stout, the petiole narrow and rather strongly elevated apically, the postpetiole being also narrow. Legs brownish yellow, the posterior femora darker, and the tips of the tibiae and tarsi blackish. Wings hyaline, stigma and veins dark fuscous; the former narrow, whitish at the base. Marginal cell wider than in the preceding species, the second section of the radius only one-third longer than the first. Areolet large, obliquely pentangular, the upper side the shortest; discocubital vein not curved, broken at the middle by a short stump of a vein; submedian cell no longer than the median.

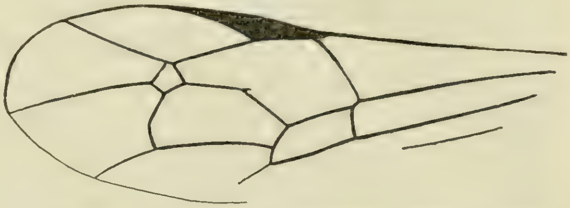

FIG. 25.— Ichneumon exesus, sp. nov. Type.

Described from one specimen and reverse.

Type.— Nos. 2112–2113, M. C. Z., Florissant, Col. (Nos. 8436 and 9126 (reverse) S. H. Scudder Coll.).

ICHNEUMON TORPEFACTUS, sp. nov. (Fig. 26.)

Female. Length 10 mm. Dark colored, wings hyaline, the abdomen conspicuously banded. Head strongly transverse; the antennae slender, with a pale annulus at the middle. First flagellar joint four times as long as thick; second and third equal, each three-fourths as long as the first and three times as long as thick; joints beyond the annulus strongly transverse. Thorax nearly smooth; scutellum large and very weakly convex. Metathorax with a large hexagonal median areola; the basal and middle lateral areas separated. Abdominal petiole black, slender, the postpetiole very finely sculptured or scabrous. Body of abdomen dark brown or piceous with a very distinct pale cross band on each segment anteriorly. Wings hyaline, the veins and stigma fuscous, the latter narrowly oval or lanceolate. Marginal cell long and narrow; the first section of the radius two-thirds as long as the second. Areolet large and regularly pentangular. Submedian cell slightly longer than the median. Legs yellowish, the posterior coxae and trochanters black.

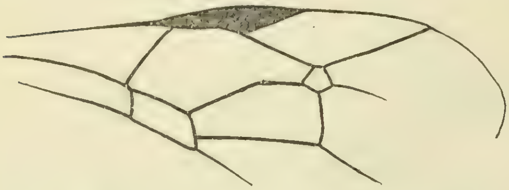

FIG. 26.— Ichneumon torpefactus, sp. nov. Type.

Type.— Nos. 2114–2115, M. C. Z., Florissant, Col. (Nos. 7572 and 7364 (reverse) S. H. Scudder Coll.).

Described from three specimens, the type and Nos. 2116–2117, Fig. 26, M. C. Z., Florissant, Col., Nos. 4587 and 4294, S. H. Scudder Coll.) which are undoubtedly the same species. There is also a fourth No. 2118, M. C. Z., Florissant, Col. (No. 13,915, S. H. Scudder Coll.) which is doubtfully referable to this species.

This is a slender species, agreeing with the subgenus Melanichneumon in most respects although the postpetiole does not appear to be punctate.

ICHNEUMON PROVECTUS, sp. nov. (Fig. 27.)

Female. Length 8 mm. Black or dark colored, the abdomen considerably lighter on the apical half and along the sutures between the segments. Antennae slender, the basal joints of the flagellum elongate, the first to fifth each at least two and one-fourth times as long as thick, the first being about four and the second three times as long as thick; joints toward the apex becoming broader and short, quite distinctly transverse. Surface of head minutely punctulate above as is also the mesonotum; posterior part of head and pleurae smooth. Metanotum completely areolated, although it is possible that the basal and middle lateral areas may be confluent. Abdomen elongate, slender; postpetiole smooth or nearly so. Ovipositor rather strongly exserted. Legs moderately stout, the hind pair brownish, with the tibiae paler, the tips of the latter and the tarsi black. Wings hyaline, with pale fuscous veins; first section of the radius fully two-thirds the length of the second; areolet rather small, its upper side shortened until it is quite irregular in shape; dis-

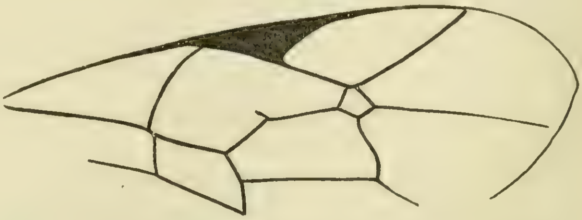

FIG. 27.— Ichneumon provectus, sp. nov. Type.

cocubital cell with a rather long stump of a vein at its middle; submedian cell a trifle longer than the median.

One specimen.

Type.— No. 2119, M. C. Z., Florissant, Col. (No. 2879, S. H. Scudder Coll.).

ICHNEUMON CANNONI, Cockerell sp. nov.

"Length 12 mm. or slightly over; anterior wing about 8.75 mm.; wings clear, nervures and stigma black or dark brown; head and thorax black, scutellum not pallid; abdomen brown, shaped as is usual in the genus, with broad pallid sutural bands, which (at least the first two) broaden medially, making a large rather diamond-shaped mark; no protruding ovipositor; antennae stout, strongly curled, ordinary, dark brown or black, with the middle of the flagellum broadly pallid (? an accident of preservation), width of flagellum 290 micra; legs ferruginous; venation normal; origin of basal nervure a little to the basal side of the transversomedial; transversomedial a little oblique, but outer side of second discoidal cell much more so; basal nervure distinctly curved; areolet small. Wing measurements in micra; depth of stigma 340; depth of marginal cell 680; stigma on marginal cell 646; length of marginal cell 2210; length of areolet 323; length of basal nervure (not allowing for curve) 935; length of transversomedial (not allowing for slight curve) 408; origin of basal nervure to origin of first recurrent 901."

"Florissant, in the Miocene shales. In the collection at the Capitol Building at Denver, in the custody of the State Historical and Natural History Society; collector unknown. Named after Mr. Cannon of Denver, in recognition of his palaeontological researches in Colorado" (T. D. A. Cockerell MS. March 5, 1908.)

ICHNEUMON DORMITANS, sp. nov.

Sex? Length about 17 mm. Black or dark brown, the abdomen ferruginous. Wings distinctly infuscated. Head rather large, antennae not preserved. Metathorax areolated, although the areas are not preserved well enough to make out clearly. Abdomen ferruginous, the petiole darker or black. The sutures are constricted somewhat giving the abdomen an appearance similar to that of the genus Trogomorpha, but I believe this is due principally to the fossilization. Legs but little preserved, but apparently dark ferruginous in color, wings distinctly infuscated; areolet obliquely pentangular, rather large. Marginal cell long, the first section of the radius considerably more than half as long as the second; insertion of transverse median vein not discernible; discocubital vein without a stump of a vein, evenly curved.

Described from one specimen.

Type.— No. 2120, M. C. Z., Florissant, Col. (No. 7992, S. H. Scudder Coll.).

ICHNEUMON CONCRETUS, sp. nov.

Female. Length 11 mm. Head and thorax principally black; abdomen principally pale rufous or ferruginous; legs black, varied with reddish; wings fulvous. Head black, antennae fuscous, the basal flagellar joints but little longer than wide, the tips of the antennae not preserved. Thorax black, more or less reddish on the metathorax. Metathorax distinctly areolated, the median areola large, to judge from the side view nearly quadrate; basal and middle lateral areas not separated. Abdomen reddish brown, the petiole very dark and the other segments stained more or less above. Abdomen considerably swollen toward the tip. Legs reddish, the femora of the four posterior legs and the apical part of their tibiae, especially those of the middle legs, black or piceous. Wings fulvous, the stigma and veins nearly concolorous; areolet large, obliquely pentangular, the upper side being short. Marginal cell narrow, the second section of the radius two and one-half times as long as the first; discocubital vein evenly curved; median and submedian cells of equal length.

Type.— No. 2121, M. C. Z., Florissant, Col. (No. 10,050, S. H. Scudder Coll.).

ICHNEUMON SOMNIATUS, sp. nov.

Female. Length 8 mm. Rather slender; black, the legs and abdomen more or less reddish brown. Head small, antennae stout, black basally and reddish brown toward the apex, the flagellum annulate with white; basal flagellar joints long, fully four times as long as thick; the apical ones much shortened, quadrate or slightly transverse. Thorax black. Areola of metathorax not visible in the specimen, the basal and middle lateral areas separated. Abdomen black, brownish beyond the third segment; postpetiole smooth, or at least not exhibiting any noticeable sculpture. Middle and hind legs dark, the anterior pair and all the tarsi brownish. Wings slightly, but distinctly infuscated; veins and stigma dark fuscous. Marginal cell rather broad, the second section of the radius nearly twice as long as the first. Areolet rather large, quite regularly pentangular. Discocubital vein angularly bent and furnished with the barest trace of a stump of a vein at the fracture. Median and submedian cells of nearly equal length.

Type.— No. 2122, M. C. Z., Florissant, Col. (No. 3014, S. H. Scudder coll.).

CRYPTINAE.

This part of the Ichneumonidae is more poorly represented than any of the other subfamilies, only three genera, Phygadeuon, Hemiteles, and Cryptus appearing in the present collection. In a previous paper ('06) I have described a species of Mesostenus from Florissant, and there are numerous records of the group from European deposits.

Brischke ('86) mentions the presence of Pezomachus in Baltic Amber, and there are in the Scudder collection now before me a couple of specimens which are possibly males of this genus.

Ichneumonites bellus, Heer ('67) is probably a cryptine. Heer has also described an Hemiteles from Radoboj and Brischke includes this genus in his list of Amber Hymenoptera ('86).

Cryptus has presumably been found a number of times, but all records except those of Gravenhorst ('35) and Brischke ('86) on Amber fauna are rather doubtful, even Heer's *C. antiquus* ('49) to judge from his figure which shows an insect with broadly sessile abdomen.

PHYGADEUON sp.

There is a single specimen in the Scudder collection, No. 600, No. 2123, M. C. Z., Florissant, Col., which belongs without much doubt to this genus, but it is not in a sufficiently good state of preservation to describe. It is dark colored, with hyaline wings, and about 6 mm. in length.

HEMITELES Gravenhorst.

Four species belonging to this genus are contained in the present series.

Key to the Florissant species of Hemiteles.

1. Stigma narrow, lanceolate, nearly four times as long as its greatest width on a line perpendicular to the costa; large species, 9–10 mm. . . . . *H. priscus,* sp. nov.
   Stigma wide, subtriangular, marginal cell less than three times as long as wide; smaller species, not over 6 mm. . . . . . 2.
2. First section of the radius distinctly shorter than the upper side of the second discoidal cell; antennae slender at base. *H. lapidescens,* sp. nov.
   First section of the radius as long or nearly as long as the upper side of the second discoidal cell . . . . 3.

3. Legs stout, marginal cell very short; discocubital vein only sightly curved . . . . *H. obtectus,* sp. nov.
Legs slender, marginal cell longer; discocubital vein very strongly arcuately bent down toward the base . *H. suffocatus,* sp. nov.

HEMITELES PRISCUS, sp. nov. (Fig. 28.)

Female. Length 9.5 mm. Head and mesonotum probably entirely dark colored, the wings slightly tinged with brownish. Metathorax and abdomen yellowish brown, each abdominal segment with a broad black band at the apex. Head as broad as the thorax, about two and one-fourth times as wide as thick antero-posteriorly. Antennae quite stout throughout, the joints quadrate or slightly wider than long. Mesonotum smooth, metanotum finely granulated and without any distinct carinae or areolation. Abdomen spatulate, the first segment rather suddenly widened at the apical third, its surface faintly roughened; remaining segments also faintly roughened, with the black bands smooth and shining. Ovipositor at least as long as the petiole of the abdomen and probably longer as its tip is not preserved. Wings slightly infuscated; stigma and veins piceous, the former pale near the base. Areolet large, open, but pentangular in position. Discocubital vein sharply broken but without a stump of a vein at the fracture. Submedian cell slightly longer than the median; transverse median vein in hind wing broken somewhat below the middle, near the lower third.

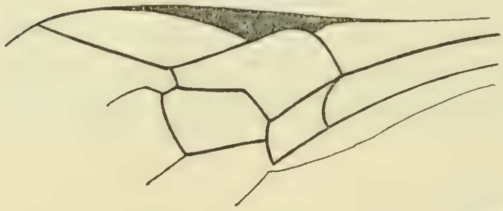

FIG. 28.— Hemiteles priscus, sp. nov. Type.

One finely preserved specimen, seen in dorsal view.

Type.— No. 2124, M. C. Z., Florissant, Col. (No. 9071, S. H. Scudder Coll.).

HEMITELES LAPIDESCENS, sp. nov.

Female. Length 6 mm. Black; the abdomen dull brownish ferruginous, petiole black at base. Antennae fuscous, the legs except posterior coxae, femora, and base of tibiae, yellowish brown. Antennae about 25-jointed, slender basally and thickened toward the apex; first and second flagellar joints of equal length, each fully five times as long as thick; third, fourth, and fifth growing shorter, those toward the apex growing quadrate. Mesonotum smooth, the metanotum partially areolated on the sides posteriorly. Abdominal petiole about as long as the metathorax; seen obliquely from the side it appears to be rather evenly curved and swollen at the apex, with the spiracles at the apical third. Seen from the side the body of the abdomen is rather slender, with a stout ovipositor that projects beyond the tip by a distance equal to one-third the length of the abdomen. Wings very faintly brownish, more distinctly so below the stigma. Stigma and veins pale fuscous, the former broad and almost subtriangular. Areolet of only moderate size, pentangular in position but open behind. Discocubital vein slightly and evenly curved; submedian cell slightly longer than the median.

One finely preserved specimen seen in lateral view.

Type.— No. 2125, M. C. Z., Florissant, Col. (No. 13,888, S. H. Scudder Coll.).

I think this is a true hemiteline although the abdominal petiole at first sight appears to be too stout and evenly curved. I am convinced, however, that this is due to twisting and splitting during the course of fossilization.

HEMITELES OBTECTUS, sp. nov. (Fig. 29.)

Female. Length 4 mm. Black, the abdomen shading to fuscous apically. Legs blackish, the hind coxae, trochanters and tibiae, except apex, brownish. Wings tinged with brownish, stigma and veins pale fuscous. Antennae rather stout, the joints of the basal part of the flagellum quadrate. Mesonotum smooth and shining. Metanotum areolated, at least on the sides. Abdomen sharply petiolate, the petiole only gradually enlarged behind (in lateral aspect) and bent down near the tip. Remaining segments of nearly equal height, the ovipositor not distinctly preserved to the tip, but apparently nearly as long as the abdomen exclusive of the petiole. Legs stout, unusually so for one of the Hemitelini, the hind femora and tibiae considerably thickened. Wings with broad, subtriangular stigma; radial cell short and broad, the first section of the radius only one-third as long as the second. Areolet open but pentangular in position. Basal nervure distinctly curved inward, the submedian cell a little longer than the median.

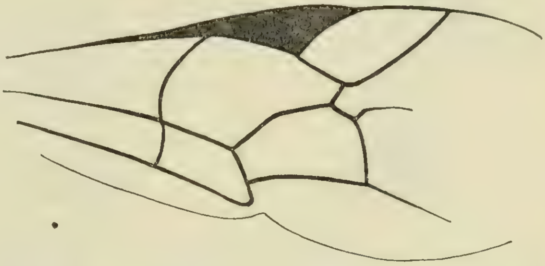

FIG. 29.— Hemiteles obtectus, sp. nov. Type.

Three specimens, one with reverse, all without doubt belonging to the same species.

Type.— No. 2126, M. C. Z., Florissant, Col. (No. 3298, S. H.

Scudder Coll.). Paratypes, Nos. 2127–2129, M. C. Z., Florissant, Col., (Nos. 5554, and 11,948, 11,966, reverse, S. H. Scudder Coll.).

I have been much in doubt concerning the proper location of this species. It is a winged female with the basal nervure rather more strongly curved than is usual among the Hemitelini, thus approaching the tribe Pezomachini, all of which are wingless in the female sex. The thick legs are also anomalous, but their appearance is quite likely due in part to compression in the stony matrix.

HEMITELES VETERNUS, sp. nov. (Fig. 30.)

Probably a male. Length about 5–6 mm. Head transverse, about twice as wide as thick, black. Antennae not preserved. Thorax elongate, twice as long as wide; smooth, not punctate. Scutellum elevated, triangularly narrowed behind. Metathorax completely areolated; median areola elongate, pentagonal; petiolar area short and broad; three lateral areas and one pleural one that may possibly be divided. Abdominal petiole long, in length equal to the metathorax and scutellum together, gradually widened, its spiracles near the tip. Following abdominal segments not or barely visible, probably lighter in color. Legs slender, more or less pale. Wings hyaline, the veins and stigma pale fuscous. Stigma subtriangular, marginal cell barely three times as long as high; areolet open, pentangular in position; discocubital vein very strongly bent toward the base, its base almost perpendicular to its tip. Second discoidal cell closed, submedian cell very slightly longer than the median.

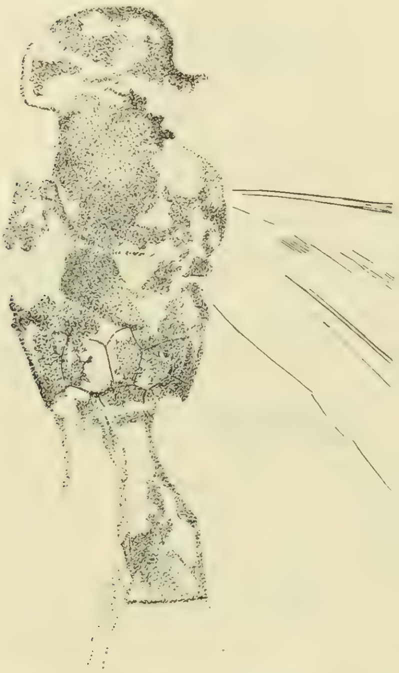

FIG. 30.— Hemiteles veternus, sp. nov. Type.

One specimen and reverse, Nos. A90 and A108 from Station 17, collected by Mrs. W. P. Cockerell. Type in the Amer. Mus. Nat. Hist.

CRYPTUS DELINEATUS, sp. nov. (Fig. 31.)

Male. Length 11 mm. Very slender, black, with the antennae, abdomen, and legs more or less brownish. Antennae short, not over two-thirds the length of the body, about 36-jointed; scape rounded; pedicel two-thirds the length of the first flagellar joint which is three times as long as thick; second to fourth twice as long as wide, the following one and one-half times for a considerable distance after which they become transverse some distance before the apex. Head rather flat, i. e. strongly transverse. Thorax smooth or very faintly punctate. Metathorax incompletely areolated although there are indications of some carinae. Abdomen very slender. Legs normal, long and moderately slender. Wings elongate, narrow, hyaline, with brown stigma and venation; stigma broadly lanceolate; radial cell quite narrow, the first section of the radius three-fourths as long as the second; areolet regularly pentangular; discocubital vein but slightly bent at the middle where there is a stump of a vein; submedian cell barely longer than the median; discoidal nervure broken below the middle.

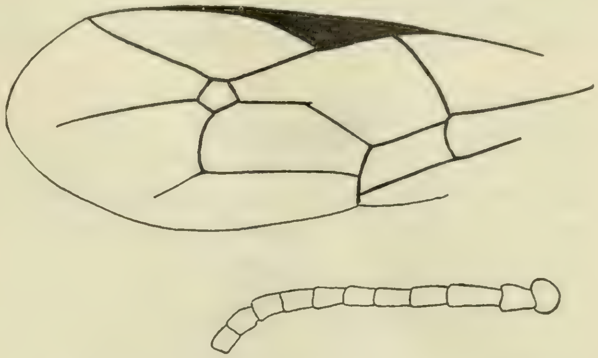

FIG. 31.— Cryptus delineatus, sp. nov. Type.

Type.— No. 2130, M. C. Z., Florissant, Col. (No. 11,962, S. H. Scudder Coll.).

One specimen, quite well preserved, and very clearly a male of Cryptus, *sensu lato,* even to the peculiar velvety surface of the antennae which is shown with wonderful fidelity.

PIMPLINAE.

Two species of Acoenites have been described, one from Radoboj by Heer ('49) and another from Florissant by Brues (:06). Although the abdominal petiole of the first species is much more strongly contracted than in species of the present day, there seems to be nothing to exclude it from location here.

LEPTOBATOPSIS ASHMEADII, sp. nov. (Fig. 32.)

Female. Length 9 mm. Light colored, probably light brownish yellow in life, like species of Paniscus. Wings hyaline. Antennae slightly shorter than the body, slender and of nearly even thickness; joints toward the base two and one-half or more times as long as thick, those toward the apex becoming almost quadrate, probably about 40 joints in all. Mesonotum and pleurae smooth. Metathorax short, declivous and obtusely rounded above. Abdomen strongly petiolate, the first segment fully one and one-half times as long as the metathorax, very slender at the base, and evenly expanded toward the tip; second half as long as the first and much expanded as seen in lateral view; remaining segments forming a pointed, ovate body. Ovipositor at least as long as the body and perhaps longer as its tip is not visible. Legs, more especially the posterior pair long and slender. Posterior coxae very long, reaching to beyond the middle of the abdominal petiole, their trochanters extending to beyond its tip. Femora short and stout, the tibiae as long as the femora and trochanters together. Wings hyaline, with light colored stigma and veins; stigma lanceolate; first section of the radius only about one-third as long as the second which is recurved in conformity with the costa, making the apical part of the marginal cell long and narrow. Median and submedian cells of equal length; discoidal nervure broken distinctly below the middle; discocubital vein evenly arcuate; areolet small, rhomboidal, distinctly petiolate above.

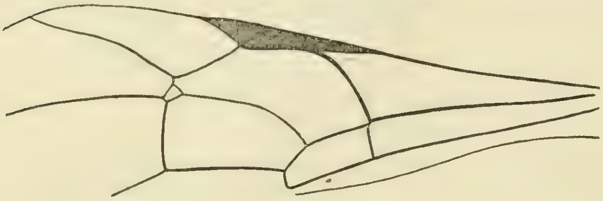

Fig. 32.— Leptobatopsis ashmeadii, sp. nov. Type.

Described from one specimen collected at Station 13B by Mrs. W. P. Cockerell. Type in the Amer. Mus. Nat. Hist.

This is an undoubted acoenitine, but seems to be midway between Leptobates and Leptobatopsis, the latter genus perhaps being closer. Unfortunately Ashmead's description of Leptobatopsis (Proc. U. S. Nat. Mus., 1909, **23**, p. 47, is very short and the type species there designated has never been described. However, the peculiar elongation of the abdomen is undoubtedly the same although the form of the areolet is more like that of Leptobates which has a nearly sessile abdomen.

The extensive group of Lissonotini has not hitherto been found in the fossil state, but I have discovered three species of Lampronota in the present collection.

Lampronota Haliday.

Key to the Florissant species of Lampronota.

1. Larger species, length 9 mm; median and submedian cells of equal length; areolet present . . . . *L. pristina*, sp. nov.
Smaller, 5 mm. 2.

2. Areolet present, median and submedian cells of equal length.
L. stygialis, sp. nov.
Areolet wanting, submedian cell longer than the median.
L. tenebrosa, sp. nov.

LAMPRONOTA PRISTINA, sp. nov.

Female. Length about 9 mm. Ovipositor 10 mm. Head and thorax blackish, probably rufo-piceous; abdomen lighter, probably dark ferruginous or pale rufous. Head not preserved; antennae long and slender; basal flagellar joint about twice as long as thick; apical ones distinctly longer than thick. Thorax smooth and shining; metathorax regularly, but not completely areolated; with two transverse carinae, a median one between these, and a lateral one from the second transverse to the apex. Abdomen slender, smooth and shining. Ovipositor very long, equal to or somewhat greater than the length of the body. Legs rather stout, brownish. Wings subhyaline, veins and stigma fusco-piceous, the latter subovate. Areolet present, triangular and subsessile above; recurrent nervure received midway between the first and second transverse cubitus; discocubital vein curved, more sharply so at the middle, but not broken. Median and submedian cells of equal length.

Type.— No. 2131, M. C. Z., Florissant, Col. (No. 16,369, S. H. Scudder Coll.).

There is another specimen received later from Professor Cockerell which appears to be the same collected at Station 14. However the ovipositor of the latter is apparently very distinctly shorter and it may represent a different species.

LAMPRONOTA STYGIALIS, sp. nov. (Fig. 33.)

Female. Length 5 mm. Ovipositor 1.6 mm. (or more?). Head and thorax black, abdomen except base ferruginous. Antennae very slender and rather long; basal joints very long, the first flagellar joint about five times as long as thick; thence growing smaller, the sixth a little more than twice as long as thick and the ones toward the apex only one-half or one-third longer than wide. Thorax smooth and shining; the metanotum very incompletely areolated, but it is so crushed in the specimen that one cannot make out the position of the one

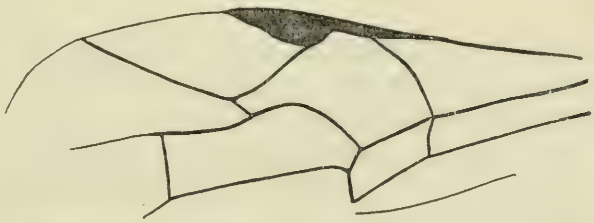

FIG. 33.— Lampronota stygialis, sp. nov. Type.

or two carinae that are present. Abdomen quite distinctly punctulate; slender, considerably enlarged apically. The ovipositor is visible for a distance equal to about two-thirds the length of the abdomen and was quite probably longer as the tip seems to be broken away. Legs entirely ferruginous. Wings hyaline, with pale fuscous veins and stigma. Areolet present, triangular, subsessile above, very long on the cubitus, the second transverse cubitus being so strongly oblique that it forms a straight line with the first abscissa of the radius. Recurrent nervure received by the cubitus far beyond the transverse cubitus; discocubital vein sharply curved and strongly bent down at its base; median and submedian cells of equal length.

Type.— No. 2132, M. C. Z., Florissant, Col. (No. 2524, S. H. Scudder Coll.).

The insertion of the recurrent nervure is peculiar in this species, being much farther from the transverse cubitus than in any living species with which I am familiar.

LAMPRONOTA TENEBROSA, sp. nov. (Fig. 34.)

Female. Length 5 mm. Ovipositor at least 6 mm. and probably longer as the tip is not visible. Black or dark colored, the apical part of the abdomen lighter. Wings hyaline. Antennae slender, the joints toward the base elongate, those near the apex only one-half longer than wide. Surface of head finely shagreened; pleurae smooth and shining. Metathorax rather low as seen in lateral aspect, evenly rounded above. Abdomen broadly sessile, its surface finely shagreened, the first segment apparently with a pair of longitudinal carinae although these may be due to pressure. Tip of abdomen considerably expanded. Legs rather stout, brownish in color. Wings hyaline, narrow. Stigma and veins dark brown, the former oval, rather broader than usual; marginal cell small, the first section of the radius not more than one-fourth the length of the second; submedian cell slightly, but distinctly longer than the median; discocubital vein slightly and evenly curved; areolet wanting, the second recurrent nervure received a considerable distance beyond the transverse cubitus, nearly the length of the first section of the radius.

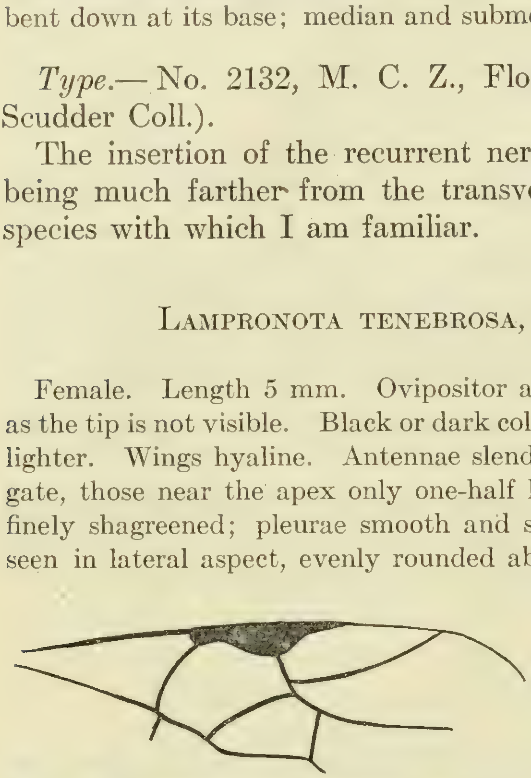

FIG. 34.— Lampronota tenebrosa, sp. nov. Type.

One specimen and reverse, Nos. B15 and B16, collected by Mr. S. A. Rohwer at Station 13B; complete, but with the details of structure not very clearly preserved. Type in the Amer. Mus. Nat. Hist.

Five genera of Pimplini, Rhyssa, Glypta, Polysphincta, Pimpla, and Xylonomus have been found in Tertiary deposits and all of these occur at Florissant. Glypta has been found by Scudder also in the Oligocene of Green River, Wyoming, Pimpla in a number of European localities and also at Quesnel, British Columbia, Rhyssa at Radoboj and at Green River. Of the entire number Pimpla is the most abundant, being represented by many species.

GLYPTA AURORA, sp. nov. (Fig. 35.)

Female. Length 9 mm. Black, sutures and tip of abdomen more or less light colored. Antennae short, about half the length of the abdomen; basal joints long; those at the middle and beyond nearly quadrate. Structure of thorax not discernible. First abdominal segment with very strong deep oblique grooves posteriorly, repeated less strongly on the second and third segments. Ovipositor preserved only at the extreme base. Wings hyaline, the stigma and veins piceous. Stigma and marginal cell very elongate and narrow; areolet wanting, the recurrent nervure received nearly the length of the transverse cubitus beyond the base of the latter. Discocubital cell rather long, the discocubital vein rather sharply bent at its middle. Median cell shorter than the submedian; transverse median vein oblique.

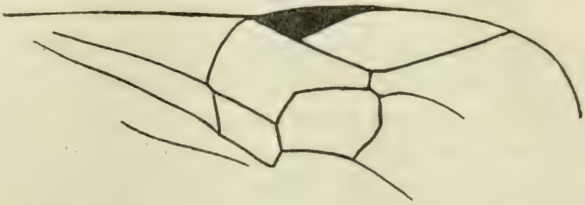

FIG. 35.— Glypta aurora, sp. nov. Type.

Type.— No. 2133, M. C. Z., Florissant, Col. (No. 8153, S. H. Scudder Coll. Not very well preserved, but the only species of Glypta in the collection.

POLYSPHINCTA Gravenhorst.

Key to the Florissant species of Polysphincta.

1. Small, slender species, 6 mm. in length, median cell distinctly shorter than the submedian . . . . *P. mortuaria,* sp. nov.
   Larger species, median and submedian cells of equal length . 2.
2. Length 12.5 mm.; transverse cubital nervure very short, not more than one-sixth as long as the greatest width of the marginal cell . . . . *P. inundata,* sp. nov.
   Length about 8 or 9 mm.; transverse cubital nervure fully one-third as long as the greatest width of the marginal cell. *P. petrorum,* sp. nov.

POLYSPHINCTA MORTUARIA, sp. nov. (Fig. 36.)

Female. Length 6.5 mm. Small, slender, principally black, but varied somewhat with brown, especially on the abdomen. Head not preserved; the central part of the antennae visible, the joints slightly longer than wide. Thorax smooth or faintly punctulate, the metanotum with indications of a transverse and a lateral longitudinal carina. Abdomen sessile, elongate, gradually enlarged to the tip. Ovipositor preserved only at the base. Legs only in part preserved. They appear to be dark in color and apparently have some of the tarsi variegated or banded. Wings hyaline, stigma fuscous; nervures slightly lighter. Stigma broadly lanceolate; marginal cell long and narrowly acuminate at the tip. Areolet wanting, the transverse cubitus long; recurrent nervure received considerably beyond the transverse cubitus. Cubitodiscoidal cell rather long, the cubitodiscoidal nervure slightly and evenly curved. Submedian cell much longer than the median, the transverse median nervure strongly oblique.

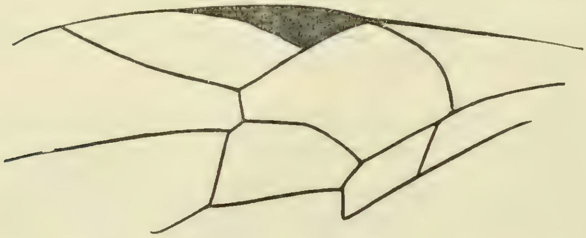
FIG. 36.— Polysphincta mortuaria, sp. nov. Type.

Type.— No. 2134, M. C. Z., Florissant, Col. (No. 13,397, S. H. Scudder Coll.).

POLYSPHINCTA INUNDATA, sp. nov.

Female. Length 12–13 mm. Large and stout; the body black, with a considerable amount of brown on the abdomen and legs. Antennae two-thirds the length of the body, slender, fusco piceous; basal joints of the flagellum about twice as long as wide; apical joints narrower, but smaller, being still twice as long as wide. Thorax quite distinctly and rather coarsely punctate, the pleurae more or less rugulose. Metanotum partially areolated. Abdomen stout, about one and one-half times as long as the head and thorax together; first segment black, more or less longitudinally rugulose and with a longitudinal lateral carina; following segments fuscous, indistinctly sculptured. Ovipositor as long as the abdomen and probably longer, as its tip is not preserved. Wings subhyaline; stigma and veins dark fuscous; stigma broadly lanceolate; marginal cell long, narrow, strongly acuminate toward the tip. Transverse cubitus very short, separated from the recurrent nervure by twice its length. Discocubital cell long, the discocubital vein rather sharply bent at its middle. Submedian cell no longer than the median, the transverse median nervure scarcely oblique.

Type.— No. 2135, M. C. Z., Florissant, Col. (No. 16,372, S. H. Scudder Coll.).

POLYSPHINCTA PETRORUM, sp. nov. (Fig. 37.)

Female. Length 8–9 mm. Entirely black, except the last abdominal segment and the apical part of the venter. Antennae nearly three-fourths as long as the body, the basal joints of the flagellum very long, fully five or more times as long as thick, apical joints suddenly becoming much shorter, subquadrate. Thorax distinctly punctulate, the pleurae and metanotum in great part finely rugose. Metathorax apparently completely areolated with the exception of the apical pleural areas; the spiracle large, oval. Abdomen nearly twice as long as the head and thorax together, much enlarged apically. First segment longitudinally aciculate and rugulose, with lateral carinae. Following segments not coarsely sculptured. Ovipositor not entirely preserved, more than one-half the length of the abdomen. Wings subhyaline, stigma and veins piceous. Marginal cell rather broad and short; transverse cubitus long, separated by about its own length from the recurrent nervure. Discocubital cell long; the discocubital vein rather sharply but only slightly bent at its middle. Median and submedian cells of equal length, the transverse median nervure scarcely oblique.

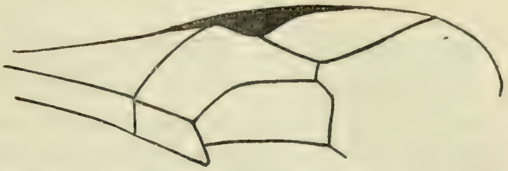

FIG. 37.— Polysphincta petrorum, sp. nov. Type.

Type.— No. 2136, M. C. Z., Florissant, Col. (No. 12,947, S. H. Scudder Coll.).

POLYSPHINCTA SAXEA Scudder.

Rept. Geol. Surv. Canada, 1875–76, 1877, p. 268.

This is probably a Polysphincta.

PIMPLA Fabricius.

Key to the Florissant species of Pimpla.

1. Discocubital vein with a long stump of a vein, areolet with a rather long petiole above; abdomen conspicuously banded.
   P. appendigera Brues.

   Discocubital vein without a stump, or at most with a slight trace of one . . . . 2.

2. Mesonotum and occiput deeply and coarsely punctate, sides of head and pleurae longitudinally rugulose; metanotum rugulose; areolet broadly sessile above . . . . *P. morticina*, sp. nov.
   Body at most punctulate, never longitudinally rugose . . . 3.
3. Areolet distinctly petiolate, petiole quite long. *P. revelata*, sp. nov.
   Areolet sessile or subsessile above . . . . 4.
4. Marginal cell and stigma long and slender, the extreme height of the cell less than three times that of the areolet. *P. senilis*, sp. nov.
   Marginal cell and stigma broad, the height of the cell considerably over five times that of the areolet . . . *P. rediviva*, sp. nov.

PIMPLA APPENDIGERA Brues.

Bull. Amer. mus. nat. hist., 1906, 22, p. 494.

This species, originally described from a single specimen, is represented in the Scudder collection by no less than twenty examples, and I have also received one from Professor Cockerell and examined another from the same deposits belonging to the British Museum.

It therefore appears to be the commonest ichneumonid occurring at Florissant and also resembles recent species of Pimpla more closely than any of the other fossil Florissant species. In addition to the original description it may be added that the size of most of the specimens is considerably in excess of that given for the type, some of them being over 10 mm. in length.

I have seen only a single male No. 2137, M. C. Z., (No. 14,285, S. H. Scudder Coll.). It is very slender and measures 7 mm. The abdomen is banded, and aside from sexual differences it resembles the female very closely.

The following are the numbers of the specimens representing this species in the material before me:

Nos. 2137–2155, M. C. Z. (S. H. Scudder Coll.). 198, 2425, 3594, 6684, 7263, 8921–(8131–8186), 8709, 9091, 16,367, 11,458, 11,468, 14,285, 12,338, 11,943, 13,776, (8080–8353). Amer. Mus. Nat. Hist., A143. British Museum, I. 7380.

PIMPLA MORTICINA, sp. nov.

Female. Length 9–10 mm. Probably entirely black. Head deeply and coarsely punctate; antennae with about 28 joints, short and stout, the basal ones being only twice as long as thick; those near the middle slightly transverse, and the apical ones strongly so. Mesonotum coarsely punctate like the head; pleurae longitudinally rugulose or corrugate. Metanotum with a superior median, petiolar, and two lateral areas fully enclosed. Spiracle large, rounded oval. Abdomen short and stout; first segment carinated and grooved laterally. Following segments shining and nearly smooth, second and third of equal length. Ovipositor short, one-half as long as the abdomen. Legs short and stout, entirely black. Wings hyaline, stigma elongate and narrow, piceous, veins piceous; marginal cell rather short. Areolet large, broadly sessile above; discocubital cell short, the discocubital vein strongly curved; median and submedian cells of equal length.

Type.— No. 2156–2157, M. C. Z., Florissant, Col. (No. 13,470 and 13,551 (reverse), S. H. Scudder Coll.).

This is a very roughly sculptured species with short, stout legs and antennae.

PIMPLA REVELATA, sp. nov. (Fig. 38.)

Female. Length 10 mm. Body black, or very dark colored; abdomen beyond the first segment rufous or ferruginous. Antennae with only the extreme base preserved; they probably had long joints, the first flagellar appearing about four times as long as thick and rather slender. Thorax above finely punctate; metanotum considerably crushed, but several carinae are evident indicating that it was areolated at least in part. Abdomen as usual in Pimpla, with slight indications of oblique grooves on the median segments; second to fifth segments of nearly equal length, each about one-third wider than long. Legs not visible in the type, but in another specimen which most probably belongs to this species, they are black with a broad pale ring on the hind tibiae, and with variegated tarsi. Wings hyaline, with pale fuscous stigma and neuration. Stigma and marginal cell long and narrow; areolet rather small, very oblique, with a long petiole above; discocubital cell long, the discocubital vein slightly angled and with a faint trace of a stump of a vein; submedian cell considerably longer than the median, the transverse median vein very oblique.

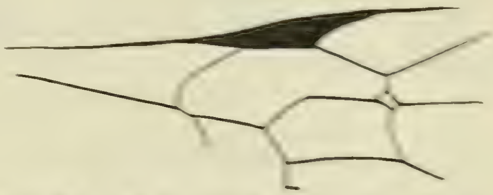

Fig. 38.— Pimpla revelata, sp. nov. Type.

Type.— No. 2158, M. C. Z., Florissant, Col. (No. 11,472, S. H. Scudder Coll.) There is also a second specimen No. 2159, M. C. Z., Florissant, Col., No. 2589, S. H. Scudder Coll.) which is most likely the same species.

PIMPLA SENILIS, sp. nov. (Fig. 39.)

Female. Length about 8.5 mm. Blackish; legs in part ferruginous, abdomen fasciate with pale bands. Head minutely punctulate; antennae long and rather slender, particularly toward the tips; joints all apparently rather short, about one-half longer than wide. Thorax punctulate like the head, the metanotum with only the faintest indications of carinae and no distinct areas. Abdomen long and rather slender, its surface regularly roughened and sparsely punctate; first segment with a strong lateral and several less evident irregular longitudinal carinae. First segment one-third longer than the second; fourth equal to the second; third somewhat shorter; first to third with pale bands apically. Ovipositor one-half as long as the abdomen, its sheaths thickly hairy. Legs moderately stout; in part ferruginous; coxae, trochanters, and perhaps the base of the hind tibiae of this lighter color. Wings hyaline, nervures and stigma piceous; stigma and marginal cell long and narrow; areolet rather large, oblique, subsessile above; discocubital cell rather short, the discocubital vein very strongly arcuately bent down basally; submedian cell considerably longer than the median, the transverse median nervure slightly oblique.

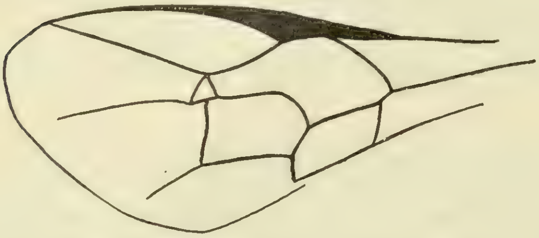

FIG. 39.— Pimpla senilis, sp. nov. Type.

Type.— No. 2160, M. C. Z., Florissant, Col. (No. 11,418, S. H. Scudder Coll.).

PIMPLA REDIVIVA, sp. nov. (Fig. 40.)

Female. Length 8 mm. Black, the apex of the abdomen brownish and the sutures between its segments pale. Head and thorax dull, but scarcely at all punctulate. Antennae not preserved. Metanotum areolated, the pleural and basal and middle lateral areas visible in the side view of the specimen. Spiracle large, rounded oval. Abdomen short, strongly punctate basally, the first segment with some rather small, but sharp carinae toward its base; second segment fully as long as the first; third, fourth, and fifth growing shorter. Ovipositor preserved only at its base; legs not preserved. Wings hyaline, with pale fuscous stigma and nervures; stigma and marginal cell rather short, the former distinctly triangular in outline. Areolet moderately small, broadly sessile above; discocubital cell long; discocubital vein

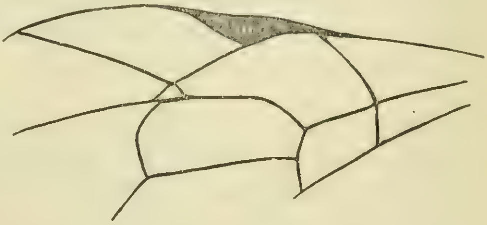

FIG. 40.— Pimpla rediviva, sp. nov. Type.

evenly but not strongly curved. Median and submedian cells of equal length.

Type.— No. 2161, M. C. Z., Florissant, Col. (No. 5546, S. H. Scudder Coll.).

PIMPLA sp.

There is also a single male Pimpla, No. 2162 M. C. Z., Florissant, Col. (No. 12,887, S. H. Scudder Coll.), but I cannot associate it with certainty with any of the foregoing species. It measures 8 mm. and has a banded abdomen.

XYLONOMUS SEJUGATUS, sp. nov.

Female. Length 15 mm. Black, the anterior legs and the posterior tibiae and tarsi brownish; abdomen more or less piceous. Wings subhyaline, clear, but with a slight trace of infuscation. Ovipositor visible for 10 mm. at which point it is broken at the edge of the stone. Size and stature of *X. humeralis* Say. Antennae only in part preserved; black, the joints near the base of the flagellum nearly twice as wide as long. Mesonotum and pleurae smooth or nearly so; metanotum distinctly, but only partially areolated as in *X. humeralis*. Abdomen twice as long as the head and thorax together, the first segment as long as the second and third combined, irregularly striated along the sides; third shorter than the second; fourth as long as the third; fifth, sixth, and seventh longer, but not much higher than the fourth, the abdomen being only gently swollen at the apex. Legs long, especially the hind pair. Hind coxae swollen, more near the base, the hind femora and tibiae rather thick. Wings with a narrow stigma which is pale at the base and fuscous apically. Nervures piceous. Areolet absent, the radial and cubital veins very closely approximated at this point where they are somewhat thickened. Marginal cell very long, the second section of the radius nearly three times as long as the first.

Described from one specimen and part of its reverse.

Type.— No. 2211–2212, M. C. Z., Florissant, Col. (No. 11,474 and 11,631, reverse, S. H. Scudder Coll.).

This is an undoubted Xylonomus, and is strikingly similar in appearance o the recent *X. humeralis* Say. It differs, however in the shorter basal segments of the abdomen, which is less strongly clavate. It is a very handsome species. No. 2213, M. C. Z., Florissant, Col. (No. 4444, S. H. Scudder Coll.) seems to be the same, but is not well enough preserved to be positively placed.

TRYPHONINAE.

This subfamily is not very abundantly represented in the Florissant fauna, although I have recognized species belonging to six genera, all of them modern and occurring in this same region at the present day. These are Mesoleptus, Tryphon, Orthocentrus, Camerotops, Exochus, and Tylecomnus.

According to Brischke ('**86**) Mesoleptus and Tryphon occur in Baltic Amber and Scudder ('**90**) has described an Eclytus from the Oligocene of Green River, Wyoming. Bassus has been said by Keferstein ('**34**) to occur in Baltic Amber.

MESOLEPTUS Gravenhorst.

Key to the Florissant species of Mesoleptus.

Areolet open . . . . *M. apertus*, sp. nov.
Areolet closed . . . . *M. exstirpatus*, sp. nov.

MESOLEPTUS APERTUS, sp. nov. (Fig. 41.)

Female. Length 5 mm. Body black or dark colored, the apical segments of the abdomen brownish; wings slightly infuscated. Head, thorax, and first abdominal segment smooth and highly polished. Antennae moderately slender, their apices not preserved in the type specimen; basal flagellar joints from two and one-half to four times as long as thick, those toward the apex somewhat transverse. Mesonotum without furrows. Scutellum strongly convex, with a large, broad groove at its base; metanotum completely, very regularly and distinctly areolated, its surface polished. Abdominal petiole slightly shorter than the metathorax, with two widely separated longitudinal discal carinae. Abdomen suddenly widened behind the petiole, oval in shape. Ovipositor one-half as long as the abdo-

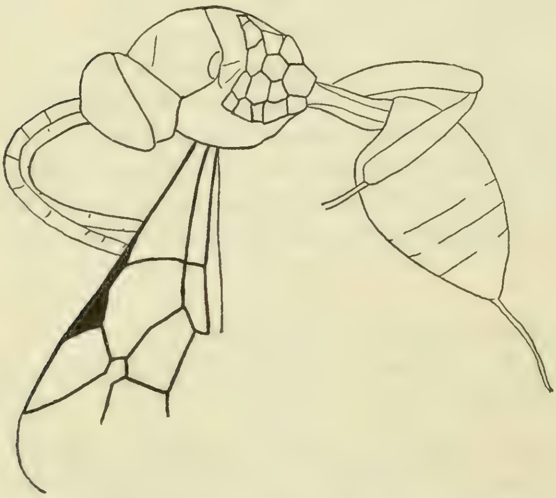

FIG. 41.— Mesoleptus apertus, sp. nov. Type.

men. Wings very slightly infuscated; stigma dark brown and veins rather light; stigma elongate, but distinctly angulate below. Marginal cell short and broad, fully twice as wide as the stigma and twice as long as thick; cubitodiscoidal cell short; areolet open; median and submedian cells of equal length.

Type.— No. 2214, M. C. Z., Florissant, Col. (No. 8893, S. H. Scudder Coll.

There is also a second No. 2215, M. C. Z., Florissant, Col. (No. 4671, S. H. Scudder Coll.) which is not so well preserved, but possibly the same species.

Mesoleptus exstirpatus, sp. nov. (Fig. 42.)

Sex? Length 6 mm. Black, the abdomen beyond the second segment reddish brown; legs yellowish, the posterior pair darker, more brownish. Wings subhyaline. Head transverse, its surface smooth and highly polished. Antennae moderately stout, of even thickness, the first joint of the flagellum twice as long as wide; following subequal, but gradually shortening; those beyond the middle but little longer than wide, apex missing. Thorax smooth and shining; metathorax areolated, apparently completely so. Abdomen as long as the head and thorax combined; slender, petiolate. Petiole evenly arcuate, with two pairs of longitudinal carinae which extend for its entire length. Wings subhyaline, the stigma narrowly oval, fuscous; veins fuscous. Sections of the radius all slightly curved; first about three-fourths the length of the third; areolet large, regularly pentangular; median and submedian cells of equal length; discocubital vein regularly and quite strongly curved.

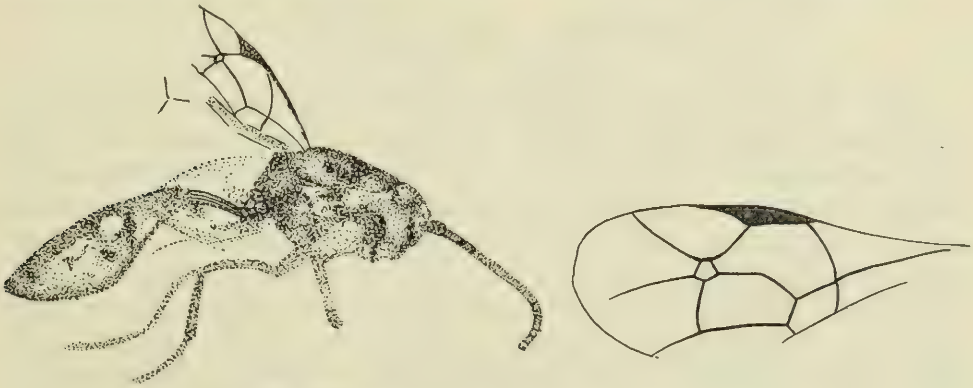

Fig. 42.— Mesoleptus exstirpatus, sp. nov. Type.

Described from one specimen collected by Mr. S. A. Rohwer at Station 14. Type in the Amer. Mus. Nat. Hist. A typical species of this extensive genus.

TRYPHON Fallen.

Key to the Florissant species of Tryphon.

1. Antennae filiform as usual in the genus; abdomen sessile or broadly petiolate . . . . 2.
   Flagellum of antennae very distinctly thickened or flattened medially; abdomen strongly petiolate . *T. lapideus,* sp. nov.
2. Stigma broad, more or less triangular in outline . . . . . 3.
   Stigma long and narrow, lanceolate . . . . 4.
3. Submedian cell considerably longer than the median; first abdominal segment with discal carinae only on the basal half. *T. cadaver,* sp. nov.
   Median and submedian cells of equal length, discal carinae on first segment of abdomen extending to the tip. *T. senex,* sp. nov.
4. Median and submedian cells of equal length, abdomen rather distinctly petiolate . . . . *T. peregrinus,* sp. nov.
   Submedian cell considerably longer than the median, abdomen broadly sessile . . . . *T. florissantensis,* sp. nov.

TRYPHON LAPIDEUS, sp. nov.

Length 7.5 mm. Black, the legs brownish and the abdomen beyond the first segment brownish or reddish. Antennae very short and stout; two-thirds the length of the body and very distinctly thickened (? flattened) near the middle of the flagellum; about 20-jointed, joints near the base fully twice as long as wide; those toward the apex of the broadened portion distinctly wider than long. Surface of head and all of thorax and pleurae shining, impunctate. Metathorax very distinctly areolated, but apparently not completely so. Abdomen quite distinctly petiolate, the petiole as long as the slope of the metathorax and gradually enlarged to the tip; second segment wider (seen in lateral view), but only one-half as high as long at apex, slightly shorter than the first; third longer than the second and distinctly more than half as high as long; following segments shorter and higher. Legs moderately stout. Wings quite distinctly infuscated, the stigma long and lanceolate; submedian cell very little longer than the median; cubitodiscoidal cell long, its narrowed apical portion being elongated. Areolet open at apex. Marginal cell rather broad and short. First recurrent nervure broken at the middle.

Type.— No. 2235, M. C. Z., Florissant, Col. (No. 1796, S. H. Scudder Coll.).

This is a very puzzling specimen and I do not feel satisfied with its present location although it is no doubt a member of the Tryphoninae.

However, the flattened antennal flagellum should make the species readily recognizable, as this character occurs only in isolated genera of the Ichneumonidae. On account of this peculiarity I dislike to leave it undescribed.

TRYPHON CADAVER, sp. nov. (Fig. 43.)

Female. Length 4.5 mm. Black; the legs and second and third segments of abdomen pale brownish or reddish, except the base of the third which is piceous; apical segment of abdomen dark brown. Head smooth, not punctate, shining. Antennae three-fourths the length of the body; rather slender; about 22-jointed, although some of the articulations are obliterated; first flagellar joint over three times as long as thick; those near the middle not quite twice as long as thick; near the apex scarcely longer than wide. Mesonotum shining, distinctly punctate toward the posterior margin; parapsidal furrows entire, deep and distinct. Metanotum shining, completely areolated. Abdomen broadly sessile, first segment only one-fourth or one-third longer than wide at tip, strongly raised medially; on its basal half with two discal carinae which strongly converge and fade out at the middle. Lateral carinae complete, very close to the margin; spiracles placed distinctly before the middle. Second segment two-thirds as long as the first and twice as wide as long; third to fourth gradually shorter and wider; fifth segment the widest. Legs rather stout, at least the posterior pair. Wings hyaline, stigma and veins light brown. Stigma broad, subtriangular; marginal cell small; second section of the radius nearly three times as long as the first. Submedian cell considerably longer than the median, the transverse median vein very oblique; cubitodiscoidal cell rather short. Areolet present, but neither of the transverse cubiti very strongly colored; first recurrent nervure broken considerably below the middle.

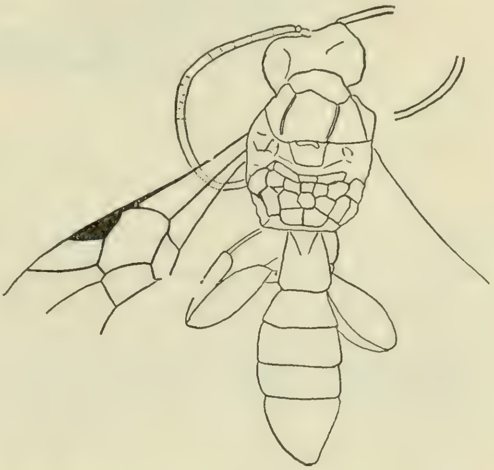

FIG. 43.— Tryphon cadaver, sp. nov. Type.

Type.— No. 2236, M. C. Z., Florissant, Col. (No. 8176, S. H. Scudder Coll.).

TRYPHON SENEX, sp. nov. (Fig. 44.)

Sex? Length about 6 mm. Apparently entirely dark colored, the legs and the apical part of the abdomen, lighter, yellowish, but this may be due to unnatural stains as the rock is strongly yellow. Antennae rather stout, the apical part not preserved; joints, even toward the base of the flagellum, quadrate. Surface of head nearly smooth but opaque. Pleurae and metanotum highly polished; propleurae roughly striated or fluted along the posterior margin, the epomial carina distinct. Metanotum more or less transversely wrinkled; areolated,— apparently completely so. Abdomen subsessile, the first segment with a pair of widely separated discal carinae that extend to the tip and a lateral carina which also extends to the tip; second and third segments subequal, each as long as the first, without grooves or carinae. Legs moderately stout. Wings hyaline, with brown stigma and veins. Stigma rather broad, almost subtriangular in form; radial cell short and broad, only twice as long as wide; first section of the radius nearly one-half as long as the second; cubitodiscoidal cell very short; median and submedian cells of equal length; first recurrent nervure broken considerably below the middle; areolet indicated, but the external vein is nearly hyaline.

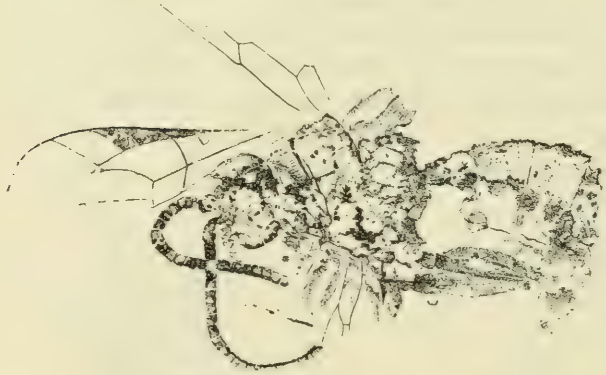

FIG. 44.— Tryphon senex, sp. nov. Type.

Described from one specimen from Professor Cockerell, No. A62. Type in the Amer. Mus. Nat. Hist.

TRYPHON PEREGRINUS, sp. nov. (Fig. 45.)

Female. Length 7 mm. Color not well preserved; probably dark, with the abdomen and legs more or less brownish or reddish. Antennae not preserved. Thorax smooth, the pleurae more or less aciculate, particularly the propleurae and the mesopleurae above. Metanotum apparently completely areolated, but the carinae are not so prominent as usual. Basally it is smooth, but apically more or less rugose. Abdomen rather distinctly petiolate, the spiracles not visible in the specimen. Second segment as long as the petiole, and seen from the side it is enlarged toward the apex which is nearly twice as high as the base; following segments gradually decreasing in length. Legs long and slender. Wings hyaline, stigma narrow, lanceolate; marginal cell also very long and slender, the first section fully one-half as long as the second. Areolet indicated as pentangular, but open behind, or at least with the closing nervure subobsolete; discocubital cell very long, its apical part being much elongated and narrow; median and submedian cells of equal length; first recurrent nervure broken just below the middle.

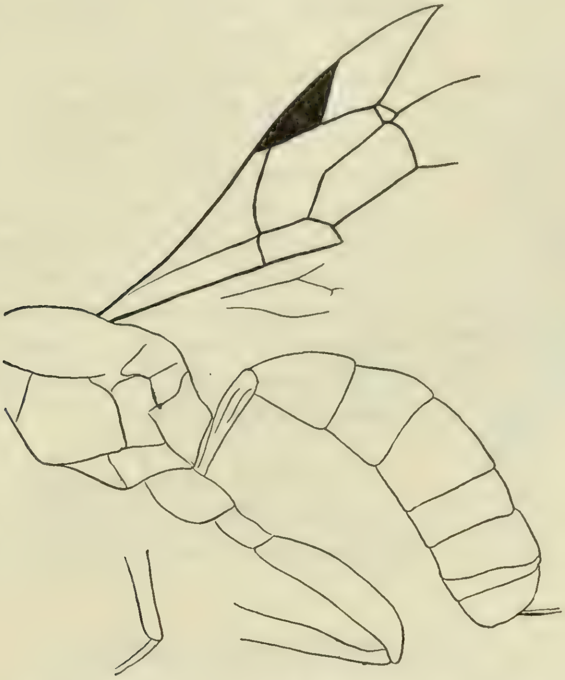

FIG. 45.— Tryphon peregrinus, sp. nov. Type.

Described from one specimen characterized by its much elongated wings.

Type.— No. 2237, M. C. Z., Florissant, Col. (No. 13,456, S. H. Scudder Coll.).

TRYPHON FLORISSANTENSIS, sp. nov. (Fig. 46.)

Sex? Length 6 mm. Black, the abdomen beyond the petiole, reddish brown. Antennae rather long and slender; four-fifths the length of the body; about 28-jointed, the joints toward the base of the flagellum about one-half longer than thick, those near the apex scarcely longer than thick. Head and thorax smooth and shining, finely punctulate; lower part of mesopleura more distinctly so. Metathorax completely areolated. Abdomen broadly sessile, the first segment with a pair of convergent discal carinae that extend to just beyond the middle, but with no lateral ones behind the spiracle which is placed distinctly before the middle. Second to sixth abdominal segments each about equal in length, and each two-thirds as long as the first. Wings hyaline, the stigma rather long, lanceolate, fuscous. Venation fuscous, the veins stout. Areolet absent, the recurrent nervure received one-half the length of the transverse cubital vein beyond the base of the latter; submedian cell longer than the median by two-thirds the length of the transverse median nervure which is strongly oblique. Marginal cell rather small and narrow, pointed, the second section of the radius two and one-half times as long as the first; first recurrent nervure broken just below the middle. Posterior legs rather stout, black, their tibiae apparently white except at base and apex.

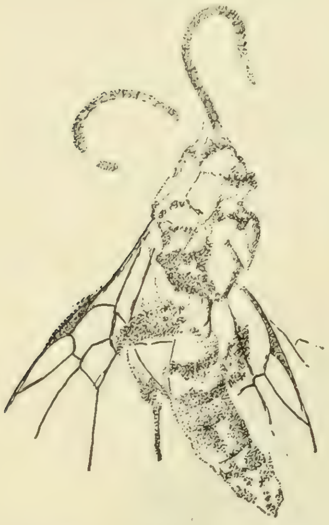

FIG. 46.— Tryphon florissantensis, sp. nov. Type.

Described from a single specimen collected by Mr. S. A. Rohwer at Station 13. Type in the Amer. Mus. Nat. Hist.

ORTHOCENTRUS Gravenhorst.

Two species are known from Florissant, one here described as new and the other characterized in a previous paper (Brues :**06**). They are separable as follows:

Key to the Florissant species of Orthocentrus.

1. Posterior tibiae scarcely longer than their femora, radius of wing evenly curved, submedian cell but little longer than the median. *O. primus* Brues.

Posterior tibiae one-third longer than their femora; radial vein strongly bent above the areolet, elsewhere nearly straight, submedian cell considerably longer than the median. *O. defossus,* sp. nov.

ORTHOCENTRUS DEFOSSUS, sp. nov. (Fig. 47.)

Sex? Length probably about 6–7 mm., the insect completely bent on itself. Black or dark colored, the abdomen beyond the petiole brownish yellow. Legs fuscous; at least the posterior pair with the trochanters considerably lighter. Antennae extremely stout and thick; the scape large, cylindrical, something over twice as long as wide; joints of the basal half of the flagellum much wider than long; those beyond more nearly quadrate; in all the flagellum is composed of about 24 joints; metathorax partially areolated, none of the carinae very strongly elevated. Abdomen gradually thickened toward the tip. Wings hyaline, the stigma dark and the veins light brown. Stigma moderately broad, about two-fifths as broad as the marginal cell which is two and one-half times as long as broad. Areolet rather large, pentangular, the vein closing it distinct but paler than the others; radial vein sharply bent over the areolet, its sections nearly straight elsewhere. Discocubital vein very little curved; transverse median vein inserted a considerable distance beyond the basal vein, but little oblique. Legs stout, but the posterior femora are not over one-third as broad as long, and one-fourth shorter than their tibiae.

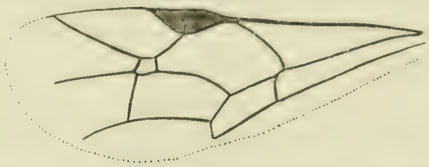

FIG. 47.— Orthocentrus defossus, sp. nov. Type.

Described from one specimen.

Type.— No. 2238, M. C. Z., Florissant, Col. (No. 10,591, S. H. Scudder Coll.).

CAMEROTOPS SOLIDATUS, sp. nov.

Sex? Length probably about 6 mm., the tip of the abdomen flaked off in the specimen. Black, the abdomen beyond the petiole and the legs brown. Antennae very stout and short; most of the joints quadrate, or barely wider than long; those near the base a trifle more elongate. Thorax shining, the sutures of the pleurae crenulate; mesopleura with a very distinct carina along its anterior margin. Metanotum only partly areolated, the pleural areas being confluent. Abdomen sessile, although rather narrowly so; the first segment very strongly convex above when seen in lateral aspect, with two median carinae which reach two-fifths the way to the tip and a lateral one which almost attains the tip. Legs very stout, the posterior femora nearly one-third as wide as long. Wings hyaline, the stigma piceous, very broad and subtriangular in outline. Radial nervure sharply bent at the insertion of the transverse cubitus, its sections nearly straight, the second over three times as long as the first.

Type.— No. 2239, M. C. Z., Florissant, Col. (No. 8309, S. H. Scudder Coll.). Described from one specimen only moderately well preserved. However, its place in the tribe is certain and the generic reference accurate beyond reasonable doubt on account of the broad stigma and the mesopleural carina.

Exochus captus, sp. nov. (Fig. 48.)

Female. Length 6 mm. Dark colored, probably black, the apical part of the abdomen brownish; legs apparently also dark. The insect from its impression appears to have been very hard-bodied and highly polished, only the mesonotum and the propleurae above showing a duller surface and faint punctulation. Antennae not well preserved but apparently typical, the joints not far from the base of the flagellum about quadrate in shape; those toward the apex seemingly considerably longer. Metathorax completely and very distinctly areolated, the areas all smooth and polished. Abdomen clavate, the carinae on the petiole reaching to about the middle of the segment, the lateral pair somewhat longer than the median ones. Second segment a trifle shorter than the petiole, the others to the sixth growing very gradually shorter. Ovipositor barely exserted. Wings hyaline, venation as usual in the genus, the stigma and marginal cell narrow; second section of the radius three times as long as the first; submedian cell much longer than the median. Legs very stout, the hind tibiae with two spurs.

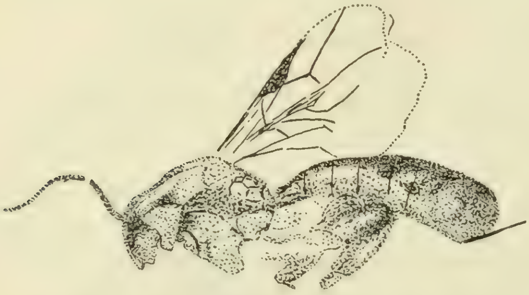

Fig. 48.— Exochus captus, sp. nov. Type.

One specimen seen in side view, well preserved and very characteristic of the tribe Exochini, although its position in the typical genus is not so certain. No. A48, type in the Amer. Mus. Nat. Hist.

Tylecomnus Holmgren.

Key to the Florissant species of Tylecomnus.

1.	Areolet open	*T. davisii,* sp. nov.
	Areolet closed and petiolate	*T. pimploides,* sp. nov.

Tylecomnus davisii, sp. nov.

Female. Length 11.5 mm. Black or dark colored, including the legs. Antennae brown; each abdominal segment with a broad pale band at the apex. Head apparently smooth above and behind, but strongly punctate on the face. Antennae setaceous, thick basally, the tips broken off with the stone; first flagellar joint about twice as long as thick and as long as the second and third together; second quadrate; third one-half longer than wide, as thick as the second; following gradually and distinctly wider toward the middle of the flagellum, beyond which they become narrower; those near the middle over twice as wide as long. Mesonotum and pleurae rather closely punctate. Metanotum finely granular, completely areolated. Abdomen nearly twice as long as the head and thorax combined, clavate, gradually enlarged to the tip. First and second segments with two complete discal and a lateral carina, those on the first regularly convergent apically. First segment nearly as long as the slope of the metathorax; second and third of about equal length, but higher; following nearly as long and gradually higher. Ovipositor short and very slender, scarcely projecting. Posterior legs rather long and stout. Wings hyaline. Stigma and veins pale. Stigma long, almost linear; marginal cell extremely long and narrow. Areolet open; cubitodiscoidal cell long and narrow. Submedian cell a little longer than the median; first recurrent nervure curved, strongly oblique, broken below the middle.

Type.— No. 2240, M. C. Z., Florissant, Col. (No. 5963, S. H. Scudder Coll.). This is a very large conspicuous species and seems without any doubt to belong here.

TYLECOMNUS PIMPLOIDES, sp. nov. (Fig. 49.)

Female. Length 14–16 mm. Apparently entirely dark colored although the type specimen is irregularly discolored and shows yellowish markings. Antennae long and stout, tapering, with very many joints; second and third flagellar joints each but little longer than wide; joints toward the middle about half wider than long; apical joints smaller, about quadrate. Head large, broadly transverse; face densely punctate. Mesonotum with deeply impressed parapsidal furrows which are widely separated at the base of the scutellum. Pleurae in front strongly horizontally wrinkled. Scutellum strongly convex, the depression at its base with high carinae laterally. Metanotum above with four carinae which separate large oblong median, lateral and pleural areas. Posterior edge with a transverse carina and posterior face with a short median carina that separates two small areas. Abdomen very broad at the base; first segment a little less than twice as long as wide, with

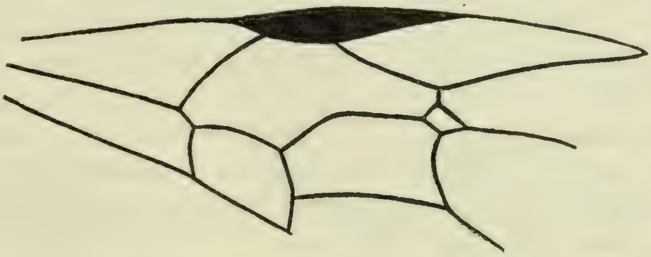

FIG. 49.— Tylecomnus pimploides, sp. nov. Type.

two very pronounced longitudinal carinae that originate near the basal angles, curve centrally and divide the segment into three nearly equal parts; they continue in a slightly divergent direction on the basal half of the second segment. Second segment at apex one-half wider than long; third, fourth, and fifth of about equal length. Wings hyaline, veins fuscous. Stigma and marginal cell long and narrow. Areolet subtriangular, with a long petiole above. Discocubital vein rather sharply curved at its middle. Submedian cell much longer than the median.

Three specimens.

Type.— No. 2241, M. C. Z., Florissant, Col. (No. 5447, S. H. Scudder Coll.). Also two specimens later sent by Professor Cockerell, Nos. B3 and B5.

This is a peculiar species and seems to be best regarded as Tylecomnus as I cannot find any other genus to which it may be certainly referred. The areolet will distinguish it from the other fossil species just as this character forms two groups among living species.

OPHIONINAE.

This group is well represented at Florissant by 23 species belonging to eleven genera, all but two of which are known by living species. Of these, three (Anomalon, Limnerium, Mesochorus) are especially prominent and are each represented by several species and numerous specimens. There have previously been recognized from the Tertiary in other parts of the World four genera, three of which, Mesochorus, Anomalon, and Porizon occur at Florissant, but only two species have been described, one Anomalon by Heer from Oeningen and one Mesochorus from Green River, Wyoming by Scudder. The latter was made the type of a new genus Lithotorus by Scudder, but it is evidently a true Mesochorus being much more typical than any of the several species here described from Florissant.

The small group Hellwigiini is represented by two living genera, both of which occur in the Old World. From Florissant, I have recognized a third which shows undoubted affinities with Hellwigia, although it is more generalized in several respects as can be seen from the following diagnosis.

PROTOHELLWIGIA, gen. nov.

Slender species of rather large size. Abdomen with a long slender petiole. Antennae about two-thirds the length of the body, rather distinctly thickened toward the middle and decreasing in thickness on apical third. Metathorax somewhat produced behind the insertion of the hind coxae. Abdominal petiole sharply thickened on the apical third; second and third segments each two-thirds as long as the first, compressed; following shorter and more strongly compressed. Wings with the stigma very slender, scarcely apparent; radial vein inserted near its middle; radial cell long and lanceolate, reaching nearly to the wing tip; transverse cubitus oblique above and strongly bowed outwardly below, meeting the cubitus barely beyond the recurrent nervure, which is almost interstitial; discocubital vein not broken; submedian cell shorter than the median and subdiscoidal nervure in front wing originating very near the upper angle of the second discoidal cell; transverse median nervure in hind wing broken near its lower third.

Type.— *P. obsoleta*, sp. nov.

I cannot reconcile the characters of the type species with those of any described genus known to me and feel compelled to add another name to the already large number of ophionine genera. The peculiar curvature of the transverse cubitus and insertion of the recurrent nervure place it definitely in the tribe Ophionini (including Hellwigiini) and close to Hellwigia from which it differs by the more generalized form of the antennae and by its different wing venation.

PROTOHELLWIGIA OBSOLETA, sp. nov. (Fig. 50.)

Length 13–17 mm. Dark colored, with hyaline wings and conspicuously banded abdomen. The abdomen has a broad pale band above at the apex of each segment (except the first) which occupies one-half of the surface. The venter is pale, with a series of black spots laterally opposite the dark bands on the dorsum. The antennae are stout, lighter colored toward the middle, with most of the joints considerable wider than long and not very distinctly separated. The body of the thorax is not very well preserved in any of the specimens, but there seem to be distinctly defined parapsidal furrows and the metanotum appears to be partially areolated. Mesonotum finely punctate, scutellum convexly elevated. Legs slender, the femora of the posterior pair slightly thickened. Wings entirely hyaline, the stigma and veins fuscous.

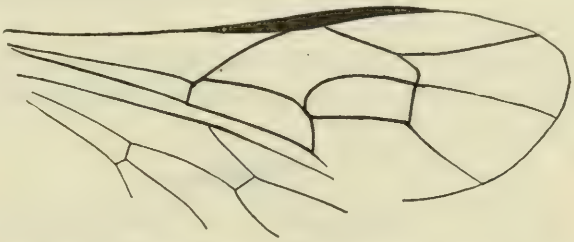

FIG. 50.— Protohellwigia obsoleta, gen. et sp. nov. Type.

There are nine specimens before me, of unknown sex, presumably females although no trace of ovipositor is preserved in any case.

Type.— No. 2242, M. C. Z., Florissant, Col. (No. 11,927, S. H. Scudder Coll.). Other specimens in the Museum of Comparative Zoölogy are:— Nos. 2243–2249, Florissant, Col. (Nos. 2138, 4795, 8086, 9043, 11,471, 14,974 and 14,983, S. H. Scudder Coll.). Professor Cockerell also sent me a well-preserved specimen with reverse collected at Station 17.

There seems to be no representative of the tribe Ophionini at Florissant, nor have any been discovered at Oeningen or Radoboj. Serres (**'29**), however, has recorded the occurrence of Ophion in the Lower Oligocene at Aix.

No representative of the tribe Nototrachini has been found in the fossil state. Its distinguishing character of a single tibial spur on the middle leg is one that can scarcely ever be made out in the fossil, so that its confusion with the preceding tribe must inevitably occur in palaeontological work.

In Europe the genus Anomalon has been recognized at two places, one species described and figured by Heer (**'49**) from the Upper Miocene at Oeningen as *Anomalon protogaeum* which very evidently belongs to the Anomalini although its position in the genus Anomalon, *s. str.* is not so certain, and Anomalon sp. by Serres at Aix in the Lower Oligocene which its describer compares with *A. variegatum*, supposedly a recent species, but one which I have not been able to locate.

In the present collections from Florissant, there are six easily recognized species of Anomalini, three belonging to Anomalon, one to Barylypa, one to Exochilum, and still another to Labrorychus.

Labrorychus latens, sp. nov. (Fig. 51.)

Probably a female. Length 11.5 mm. Color apparently brownish or rufous with the dorsal parts of the thorax darker. Wings hyaline; head and thorax not particularly well preserved, the metathorax roughly rugose-reticulate, rather gently declivous behind. First two segments of abdomen long and slender, the following much enlarged and flattened and lighter in color than the basal two. Wings short and broad, the stigma very slender, almost linear, but distinct; piceous; veins light fuscous. Marginal cell long, gradually

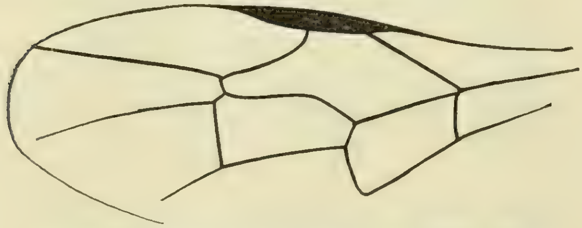

Fig. 51.— Labrorychus latens, sp. nov. Type.

narrower toward the tip, the second section of the radius twice the length of the first; median and submedian cells of equal length or nearly so, the submedian being indistinctly the longer. Discocubital vein strongly curved inwardly at the base, without stump of a vein. Transverse cubitus less than one-half as long as the distance from it to the insertion of the second recurrent nervure; discoidal nervure broken just above the middle. Legs moderately stout, the posterior femora thickened; tarsi slender.

One specimen, seen in side view, with the front wings very finely preserved, but the body only moderately so.

Type.— No. 2250, M. C. Z., Florissant, Col. (No. 9290, S. H. Scudder Coll.).

In Szépligeti's arrangement of the Ophioninae (Genera Insectorum, fasc. 34) this species can be readily traced to this genus, with which it appears to agree in all essential particulars.

ANOMALON Gravenhorst.

Key to the Florissant species of Anomalon.

1. Submedian cell longer than the median by one-third the length of the transverse median nervure; second recurrent nervure inserted the length of the transverse cubitus beyond the tip of the cubitodiscoidal cell . . . . *A. confertum*, sp. nov.
   Submedian cell not or indistinctly longer than the median; recurrent nervure inserted nearer to the tip of the cubitodiscoidal cell 2.
2. First recurrent nervure received just before the basal third of the discocubital cell, wings infuscated, brownish. *A. deletum*, sp. nov.
   First recurrent nervure received nearer to the middle than to the basal third of the discocubital cell, wings hyaline. *A. excisum*, sp. nov.

ANOMALON CONFERTUM, sp. nov. (Fig. 52.)

Length 9–14 mm. Dark colored, the abdomen no lighter than the head and thorax. Wings hyaline. Head above polished, shining, but the projecting lower portion (probably the face and clypeus) is transversely rugose. Mesonotum shining, faintly shagreened, with plainly marked parapsidal furrows which meet in a deeply impressed transverse depression at the base of the scutellum; scutellum strongly elevated, pyramidal, strongly punctate. Metanotum with four equidistant longitudinal carinae that extend less than half way to the tip, and one transverse carina near the base, the series enclosing six quadrate areas, the posterior series of which are open behind. Remainder of metathorax strongly, roughly and irregularly rugose. Abdomen slender and rather broad at the tip, no trace of ovipositor preserved. First abdominal segment as long as the metathorax, enlarged rather gradually at the apex; second a very little longer; the two together as long as the entire thorax. Legs as usual, apparently entirely dark colored. Wings hyaline; stigma very narrow, reddish fuscous; veins fuscous. Submedian cell longer than the median by a distance equal to one-third the length of the transverse median nervure. First recurrent nervure received a little beyond the basal third of the discocubital cell; the second, the length of the transverse cubitus beyond the tip of the cell. Discocubital vein bent distinctly at the middle, forming an angle of about 135° with the discoidal nervure.

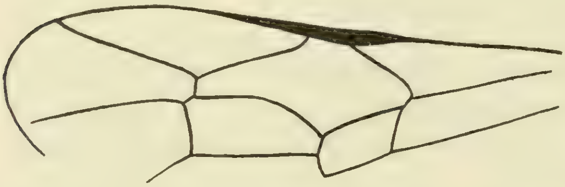

Fig. 52.— Anomalon confertum, sp. nov. Type.

Described from one specimen with its reverse.

Type.— Nos. 2251–2252, M. C. Z., Florissant, Col. (No. 8049–8766, S. H. Scudder Coll.).

There is also another specimen and its reverse, Nos. 2253–2254, M. C. Z., Florissant, Col. (Nos. 11,446–13,775, S. H. Scudder Coll.). which I believe belong to this species, although their color is more like that of the following species, the abdomen being reddish, lighter on the head and thorax. They are somewhat longer, 12 mm. in length, but the wing venation is identical.

Anomalon excisum, sp. nov. (Fig. 53.)

Female. Length 16 mm. Black or dark colored, with the flattened part of the abdomen lighter reddish brown. Antennae long, many jointed, involute toward the tips where the joints are about one-half wider than long; basal flagellar joints more nearly quadrate. Thorax higher than usual and short, less than twice as long as high when seen from the sides. Abdomen unusually slender at its base; first

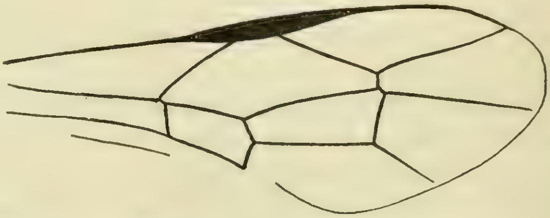

Fig. 53.— Anomalon excisum, sp. nov. Cotype.

segment rather suddenly enlarged at the tip, only a little more than one-half as long as the second, which is very gradually widened apically, until the tip is one-half wider than the base. Beyond this it is rather suddenly broadened. Legs stout; the posterior femora clavate, the thickened apical part twice as long as the slender basal portion and one-fourth as wide as the length of the femur. Posterior tibiae at tip three-fourths as thick as the broadest part of the femur. Metatarsus thickened. Wings hyaline; stigma and veins piceous, the former very slender; marginal cell as long as the discocubital; submedian cell very little longer than the median; discocubital nervure faintly arcuate inward, nearly straight; first recurrent nervure received a short distance before the middle of the discocubital cell; second, half the length of the transverse cubitus beyond its tip. Transverse median nervure of hind wing broken a short distance below the middle.

Type.— No. 2255, M. C. Z., Florissant, Col. (No. 8697 and 8765 (reverse) S. H. Scudder Coll.).

ANOMALON DELETUM, sp. nov.

Female. Length 8 mm. Ovipositor 2.5 mm. Black, the abdomen reddish brown; front and middle legs brownish yellow; wings with a strong brownish tinge. Antennae long and many jointed, but more nearly of an even thickness throughout than in recent species of the genus. They have apparently something over 40 joints and are not attenuated at the tip, the apical joint being as wide as the preceding ones and somewhat longer, the latter each about twice as long as thick; basal joints no thicker, but longer, three or four times as long as thick. Head smooth, mandibles brown. Mesonotum very finely sculptured, nearly smooth; metathorax not well preserved; first abdominal segment gradually enlarged to the tip, very finely longitudinally striated on its posterior half; second one-half longer than the first, but little broadened toward the tip; third enlarged, following as usual. Ovipositor longer than usual. Legs stout, the posterior tibiae thickened, with a long spur. Wings brownish, stigma and veins fuscous, the former narrow, lanceolate; discocubital cell distinctly longer than the marginal, its discoidal side arcuately curved inwardly; first recurrent nervure received just before the basal third of the cubitodiscoidal cell; second, one-third the length of the transverse cubitus beyond its tip; submedian cell not or indistinctly longer than the median.

One specimen, well preserved in lateral aspect.

Type.— No. 2256, M. C. Z., Florissant, Col. (No. 11,481, S. H. Scudder Coll.).

ANOMALON sp.

There is a smaller specimen, No. 2257 M. C. Z., Florissant, Col. (No. 9070, S. H. Scudder Coll.) belonging to this genus or to one closely related, apparently different from the ones described, but too poorly preserved to be identified with certainty. It is black, with a reddish abdomen and measures only 5.5 mm. in length.

BARYLYPA PRIMIGENA, sp. nov.

Female. Length 8 mm. Dark colored, the abdomen unicolored; more brownish. Wings slightly infuscated. Antennae long setaceous, reaching to the tip of the petiole of the abdomen. Thorax gently sloping behind, the metanotum rugulose near the tip. Parapsidal furrows present. Abdomen strongly compressed apically, suddenly enlarged from the base of the third segment; fifth and sixth segments higher than the height of the thorax when seen in profile. Ovipositor projecting to a distance equal to the length of the sixth abdominal segment. Petiole and second segment both slender, of about equal length, the first but little swollen at the apex, the second gradually broadened, third a little longer than high at the tip; fourth similarly shaped, but nearly three times as high at the tip as the third; the next two a little higher, about equal; seventh not so high. Posterior legs rather stout, the femora slightly clavate, no broader than the tibiae. Metatarsus thickened. Wings slightly, but distinctly infuscated, stigma moderately narrow, lanceolate. Venation not very well preserved, but the second recurrent nervure appears to be very nearly interstitial with the transverse cubitus; submedian cell considerably longer than the median.

Type.— No. 2258, M. C. Z., Florissant, Col. (No. 13,934, S. H. Scudder Coll.).

Although the wing venation of the specimen is somewhat obscure, the body has the habitus of Barylypa and all characters discernible point to its location in this genus.

EXOCHILUM INUSITATUM, sp. nov.

Female. Length 8–9 mm. Dark colored, the abdomen beyond the second segment more or less brownish or dark yellow, especially below. Face and four anterior legs also paler. Antennae short and rather stout, scarcely over one-half the length of the body; with about 32 joints and not much attenuated at the tips. Joints near the base of the flagellum fully twice as long as thick; those near the middle quadrate, and those near the apex distinctly longer than wide. Mesonotum and mesopleurae smooth and shining.

Metanotum coarsely rugose-reticulate, its tip produced beyond the insertion of the hind coxae. Abdominal petiole as long as the slope of the metathorax, rather suddenly widened above at the tip; second segment one-fourth longer than the first, slender and very gradually widened to the tip where it is one-fourth as high as long; third three-fifths as long as the second and twice as high at the tip; third a little shorter than either the fourth, fifth or sixth which are subequal. Ovipositor nearly as long as the petiole. Hind legs long as is usual in the genus, the tibia as long as the trochanters and femur together; metatarsus twice as long as the second joint. Wings distinctly infuscated, fulvous. Marginal cell long, about three and one-half times as long as its greatest width, its second section twice as long as the first; transverse cubitus long, distinct; nervure at tip of third discoidal cell broken at its middle, its parts meeting at a distinct though very obtuse angle.

Type.— No. 2259, M. C. Z., Florissant, Col. (No. 1334, S. H. Scudder Coll.).

This is a rather puzzling form on account of its antennae which are shorter, with fewer joints, and not so distinctly setaceous as those of recent forms belonging to this tribe. However, its seems to agree with Exochilum in other respects and I hesitate to erect a new genus for its reception.

Aside from the doubtful Ophion or Campoplex discovered by Sordelli ('**82**) in the Quaternary at Pianico, Italy, no fossil members of the Campoplegini have been so far described. I have found two genera among the Florissant collection, one apparently undescribed, represented by two species, and the other Limnerium *sensu lato,* a very widely distributed recent genus, represented by five species.

HIATENSOR, gen. nov.

Body elongate, the metathorax produced posteriorly between the insertion of the posterior coxae into the neck-shaped tip characteristic of the Anomalini and Campoplegini. Abdomen shaped as in Campoplex; clavate, the first and second segments forming a long pedicel which slightly exceeds the length of the remainder of the abdomen in the type species, but is shorter in the second species. Hind legs exceedingly elongate, the tips of the femora extending considerably beyond the tip of the abdomen. The coxae are not particularly elongate, but the trochanters, femora, and tibiae as well as the tarsi are much longer than usual; the femora are strongly clavate, thickened on their apical one-half, being four or five times as thick at the apical third as at the base. Tibiae as long as the femora, with a short spur; tarsi slender, not at all thickened. Wing with a very slender, nearly linear stigma; areolet wanting, the second transverse cubitus long; recurrent nervure received just beyond it; first recurrent nervure received before the basal third of the discocubital cell; submedian cell slightly longer than the median.

Type.— *H. semirutus*, sp. nov.

The type species is evidently a true campoplegine, but I cannot reconcile its peculiar habitus with any recent genus, and I believe it worthy of generic rank.

HIATENSOR SEMIRUTUS, sp. nov. (Figs. 54, 55.)

Female? Length about 9 mm. Apparently brown, with the apical portion of the hind femora and the apical part of the abdomen darker. Head not preserved. Mesothorax smooth; metathorax regularly coarsely rugulose. Abdominal petiole as long as the slope of the metathorax, swollen only slightly at the tip, the second segment about a quarter longer and but little thicker at apex than at base; remaining segments forming an ovate body. The tip of the abdomen is pointed and I believe the specimen is a female, although no ovipositor can be distinctly seen. Wings hyaline, stigma piceous; veins reddish fuscous; marginal cell long and pointed; both sections of the radius straight; discocubital cell twice as long as high, its limiting nervures nearly straight, except the basal vein which is slightly curved.

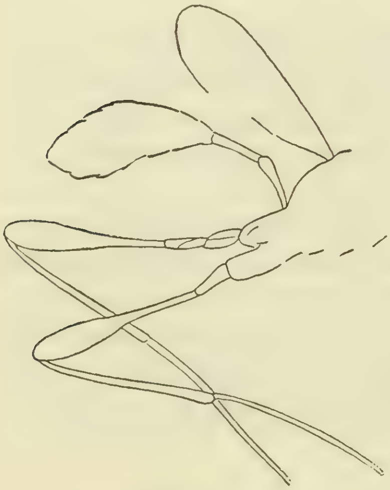

FIG. 54.

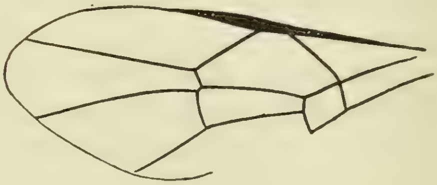

FIG. 55.

FIG. 54.— Hiatensor semirutus, gen. et sp. nov. Profile of type; FIG. 55.—Wing.

Described from one specimen well preserved, except the head which is chipped off from the stone.

Type.— No. 2260, M. C. Z., Florissant, Col. (No. 8396, S. H. Scudder Coll.).

HIATENSOR FUNDITUS, sp. nov. (Fig. 56.)

Female. Length 8 mm. Head and thorax black above, the mouthparts and the lower part of the thorax, except the hind coxae, yellowish. Abdomen black, the apical four segments more or less reddish brown on their basal portions. Hind legs black; anterior and middle pairs yellowish, their tarsi darker apically; wings hyaline. Antennae long slender, and of even thickness throughout; most of the joints about three times as long as wide. Mesonotum shining; metathorax coarsely and regularly rugose reticulate. First abdominal segment as long as the metathorax, very gradually swollen toward the tip; second as long as the first; body of abdomen gradually enlarged behind, compressed; third segment much enlarged behind, three-fourths as long as the second and nearly as high behind as it is long; fourth and fifth widening; sixth and seventh narrowing slightly, the latter rounded behind; ovipositor short, one-half as long as the abdominal petiole and flattened blade-like. Posterior legs very long, but shorter than in the preceding species, the apex of the femora, reaching just about to the tip of the abdomen, the femora clavate, the thickening beginning just beyond the middle, the thickest part four times as thick as the slender basal portion. Wings with narrow stigma, the marginal cell narrow; first section of the radius hardly longer than the basal vein; first recurrent nervure received just beyond the basal one-fourth of the discocubital cell; second recurrent nervure received just beyond the first transverse cubitus.

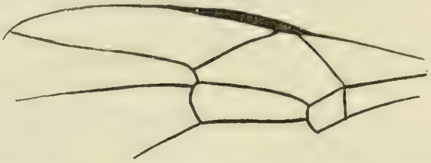

FIG. 56.— Hiatensor funditus, sp. nov. Type.

Type.— Nos. 2261–2262, M. C. Z., Florissant, Col. (No. 408 and 7167 (reverse), S. H. Scudder Coll.).

This resembles *H. semirutus* in the extremely elongate and clavate form of the hind femora, but differs by the narrower marginal cell and shorter second abdominal segment; otherwise they are very similar and I think undoubtedly congeneric.

LIMNERIUM Holmgren.

Key to the Florissant species of Limnerium.

1. Areolet either petiolate or touching the radius in a point with its upper angle just attaining the radius . . . . 2.
   Areolet distinctly sessile above, i. e. with a distinct radial side.
   L. vetustum, sp. nov.

2. Abdomen strongly petiolate as usual in the genus . . . . 3.
Abdomen only subpetiolate; recalling to some extent the form which it assumes in certain species of *Lampronota*; areolet distinctly petiolate . . . . *L. plenum*, sp. nov.
3. Areolet small, plainly petiolate, the petiole one-half as long as the cubitodiscoidal side of the areolet . . *L. depositum*, sp. nov.
Areolet large, touching the radius in a point . . . . 4.
4. Abdomen slender, the second segment nearly as long as the petiole. *L. consuetum*, sp. nov.
Abdomen shorter and stouter, the second segment only a little more than one-half the length of the petiole *L. tectum*, sp. nov.

LIMNERIUM VETUSTUM, sp. nov.

Female. Length 6 mm. Body dark, probably black, the antennae more brownish; abdomen higher below and toward the apex; posterior coxae and legs reddish brown; the femora blackened on the apical one-half, slender and only imperceptibly thickened before the apex; surface of mesonotum smooth; metanotum with all three lateral and three pleural areas separated; ovipositor dark, as long as the abdomen from the tip of the second segment. Wings somewhat infuscated, with a brownish tinge; veins fuscous, stigma lanceolate; first section of the radius nearly one-half as long as the second, the two forming a very oblique angle; areolet large, with a distinct radial side.

Described from two specimens.

Type.— No. 2263, M. C. Z., Florissant, Col. (No. 11,459, S. H. Scudder Coll.). Also No. 2264, M. C. Z., Florissant, Col. (No. 13,847, S. H. Scudder Coll.).

There is another specimen, No. 2265, M. C. Z., Florissant, Col. (No. 11,906, S. H. Scudder Coll.) which is probably the same species. It has the hind femora and tibiae black, but otherwise so far as I can make out is identical, although it is not so well preserved as might be desired.

This resembles *L. tectum*, but has more slender legs, the posterior femora being not nearly so thick, with nearly parallel sides, whereas in *L. tectum* they are arcuately thickened at the middle both above and below. The areolet is also much broader above, resting with a distinct side along the radial vein.

LIMNERIUM PLENUM, sp. nov. (Fig. 57.)

Female. Length 5.5 mm. Black, the legs brownish testaceous, the tips of the femora, tips of the tibiae and tarsi of posterior pair blackened. Abdomen dark, lighter toward the tip and on the venter; antennae slender, many jointed (about 30–35), the joints toward the middle one-half longer than wide, and only slightly thicker than the apical joints which are distinctly longer than wide. Surface of thorax rougher than usual in the genus; metathorax completely areolated, the basal pleural and second pleural areas completely separated; basally the metanotum is nearly smooth but apically it is very distinctly rugose-reticulate. Abdomen much shorter and stouter than usual; first segment short, not so long as the posterior slope of the metathorax; second segment a little shorter than the first; third to sixth about equal in length; terminal segment longer. Ovipositor issuing from the base of the fifth segment, from its extreme base to tip nearly as long as the abdomen exclusive of the petiole. Wings yellowish hyaline; stigma fuscous; veins pale brown; stigma rather broad, one-half as wide as the marginal cell; second section of the radius twice as long as the first; areolet small, triangular, distinctly but shortly petiolate above; submedian cell slightly but plainly longer than the median.

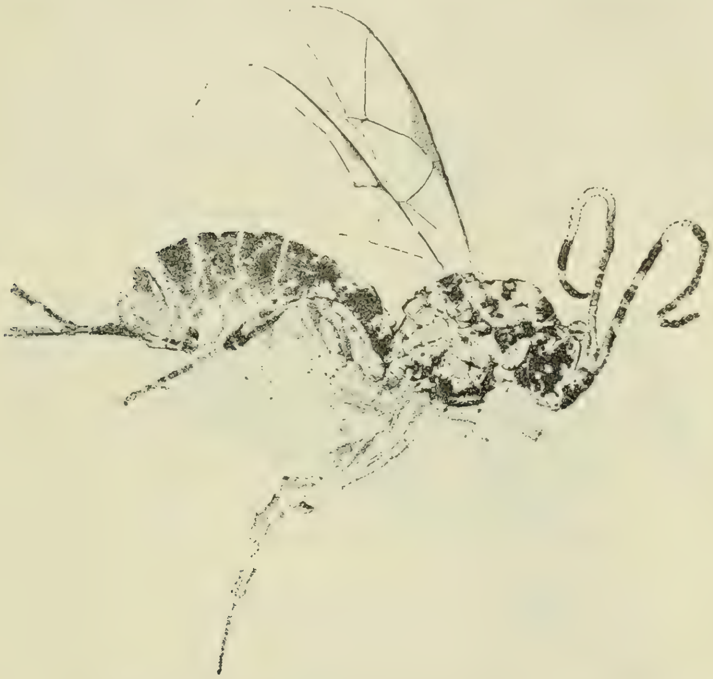

FIG. 57.— Limnerium plenum, sp. nov. Type.

Described from one specimen with its reverse, both quite well preserved, from Station No. 17, collected by Mrs. W. P. Cockerell.

No. A77, type in the Amer. Mus. Nat. Hist. This species could not be referred to Limnerium, *sensu stricto* if living, but as I can place it nowhere else from a study of the material at hand, it has seemed advisable to place it here, where it will no doubt be sought if additional specimens are secured in the future.

LIMNERIUM DEPOSITUM, sp. nov. (Fig. 58.)

Female. Length 6 mm. Black, the abdomen stained with rufous as follows: a small spot on the side of the second segment near the tip; third segment at the base and below on the sides. Fourth to sixth piceous above, rufous anteriorly and below on the sides. Four anterior legs pale, the posterior pair blackish with fuscous tarsi. Surface of head, thorax and pleurae coriaceous or minutely punctulate. Antennae long and slender, with probably somewhat over 30 joints; joints near the middle of the flagellum one and one-half times as long as thick, much thicker than those toward the apex which are quadrate. Metathorax areolated, but apparently the pleural areas are not separated, its surface finely punctulate. Abdomen of the usual form for the genus, the petiole clavately thickened, a trifle longer than the posterior slope of the metathorax; second segment two-thirds as long as the first; third shorter and much wider in lateral aspect. Ovipositor originating at the base of the fifth segment, from its extreme base to tip nearly as long as the abdomen exclusive of the petiole and second segment. Wings hyaline; stigma piceous, oval lanceolate; veins brown; marginal cell at its widest part two and one-half times as wide as the stigma; second segment of the radius straight, twice as long as the first; areolet of moderate size, with a long petiole above, which is over one-half as long as the cubitodiscoidal side of the areolet; median and submedian cells of equal length.

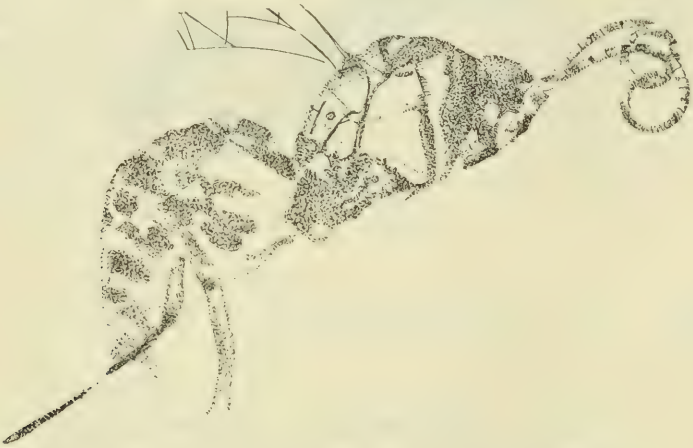

FIG. 58.— Limnerium depositum, sp. nov. Type.

One specimen, No. A58, collected by Mr. S. A. Rohwer at Station 14. Type in the Amer. Mus. Nat. Hist.

This is a very typical species of Limnerium in all respects and appears to be a close relative of some living forms.

LIMNERIUM CONSUETUM, sp. nov. (Fig. 59.)

Female. Length 5 mm. Dark colored, reddish on the abdomen below from the third segment to the tip; legs yellowish, the posterior pair darker. Antennae rather short, slender, particularly near the base of the flagellum. The number of joints is not plain, but there are apparently fewer than in the other species here described. Surface of thorax roughly shagreened or punctulate, the metanotum arcuately rounded behind and not completely areolated although the pleural areas are strongly marked and the lateral ones indistinctly separated. Abdomen slender at the base, but strongly compressed apically, its surface coriaceous. Petiole as long as the entire slope of the metathorax, slender at the base and clavately thickened apically; second segment very long, a little longer than the first; third shorter, but still a little longer than its height at the tip. Following segments strongly compressed. Ovipositor issuing from the base of the sixth segment, as long as the abdomen exclusive of the first three segments. Wings hyaline; stigma dark brown and veins pale brown; stigma rather slender, two-fifths as wide as the marginal cell which is somewhat broader than in the other species. Areolet triangular, large, its upper point touching the radius; second section of the radius about twice as long as the first. Median and submedian cells of approximately equal length.

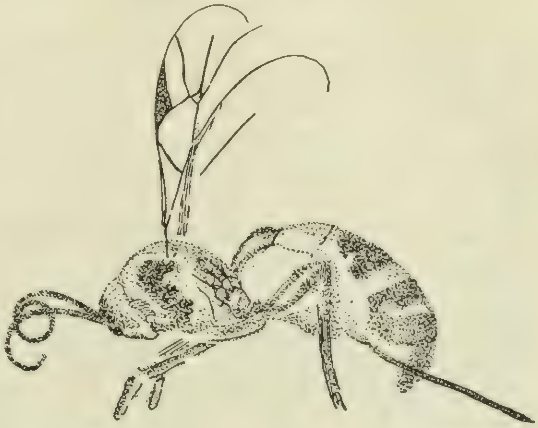

FIG. 59.— Limnerium consuetum, sp. nov. Type.

One specimen, No. A112, collected at Station 14 and sent by Professor Cockerell. Type in the Amer. Mus. Nat. Hist.

This is a typical species of the genus.

LIMNERIUM TECTUM, sp. nov. (Fig. 60.)

Female. Length 5.5 mm. Black, the third and following segments reddish brown below; wings hyaline. Antennae about 28-jointed, indistinctly thicker toward the middle of the flagellum where the joints are about twice as long as thick; joints near the apex shorter and not quite so thick. Seen from the side the upper surface of the thorax is evenly arcuate. Mesonotum with the coriaceous sculpture characteristic of recent species of Limnerium. Metanotum with the first and second lateral areas separate; the first and second pleural areas apparently confluent, but the third separated from the second. Abdomen of the usual form; the petiole gradually thickened, then slightly narrowed just before the tip; three times as long as high. Ovipositor as long as the abdomen from the tip of the second segment. Legs stout, especially the hind femora; hind tarsi apparently pale at the base. Stigma and veins piceous; stigma oval-lanceolate, rather narrow; marginal cell wide, the first section of the radius a little more than one-third the length of the second. Areolet large, oblique, rhomboidal, narrowed above to a point but not petiolate.

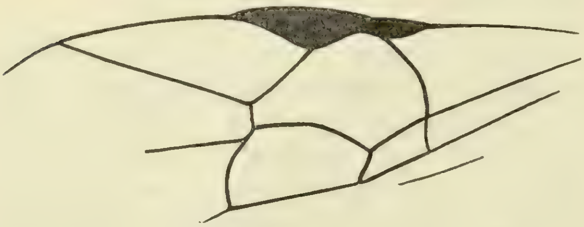

FIG. 60.— Limnerium tectum, sp. nov. Type.

Type.— No. 2266, M. C. Z., Florissant, Col. (No. 2296, S. H. Scudder Coll.).

This is a typical species of Limnerium, quite similar to some of the living forms of this very extensive genus.

No fossil representatives of the Paniscini have previously been discovered, but I have found species belonging to two living genera, Absyrtus and Parabates in the present collection, and possibly a species of a third, Opheltes.

ABSYRTUS DECREPITUS, sp. nov. (Fig. 61.)

Sex? (probably a female). Length 7.25 mm. Black, the abdomen beyond the first segment brown with pale bands on the bases of the segments. Antennae scarcely preserved, but they were probably quite stout and with the joints near the middle of the flagellum quadrate or slightly longer than thick. Mesonotum and pleurae smooth; metathorax areolated, at least near the tip. Abdomen long and of nearly even width beyond the first segment which is twice as long as broad and finely longitudinally rugulose; second rapidly widened, as long as broad at the tip; third to sixth

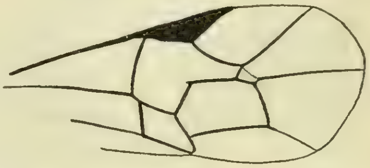

FIG. 61.— Absyrtus decrepitus, sp. nov. Type.

gradually shorter, seventh and eighth more rapidly so. Legs, as far as preserved, pale brown. Wings hyaline, stigma and veins light brown, the former rather broadly ovate. Radial cell short and broad, the first section of the radius fully two-thirds as long as the second; discocubital vein composed of two straight segments, which meet sharply at almost a right angle; submedian cell considerably longer than the median; discoidal nervure broken much below the middle; areolet rather small, quite indistinctly closed; very obliquely rhomboidal, receiving the recurrent nervure near the tip.

Type.— No. 2268, M. C. Z., Florissant, Col. (No. 6876, S. H. Scudder Coll.).

One specimen, not very well preserved, but extremely characteristic on account of the angular course of the discocubital vein. This peculiarity and its general appearance make me place it here.

PARABATES MEMORIALIS, sp. nov. (Fig. 62.)

Probably a female. Length 17 mm. Dark colored, the abdomen conspicuously banded. Wings distinctly infuscated. Head apparently strongly transverse, the antennae stout, but very much tapered apically; joints near the base of the flagellum approximately as long as thick, those toward the apex becoming very little shorter in proportion to their width. Thorax rather shining, its surface punctulate although faintly so. Metathorax apparently with a few carinae, but not completely areolated. Abdomen large and stout, much compressed, club-shaped apically and subpetiolate at the base; first to fifth segments pale colored, with dark apical cross bands; apex of abdomen dark. Ovipositor not preserved although the specimen is probably a female. Legs, especially the posterior pair, long and stout; dark colored, the tarsi pale. Wings ample, quite distinctly infuscated; stigma and veins fuscous, the former lanceolate in form. Marginal cell long and narrow; second section of the radius arcuate inwardly and then recurved at its tip, twice the length of the first; submedian cell very slightly longer than the median; cubitodiscoidal vein very indistinctly broken near the middle, with a slight trace of a stump of a vein at this point; areolet small, four-sided, the upper two sides the longest, petiolate above, the petiole as long as the height of the areolet.

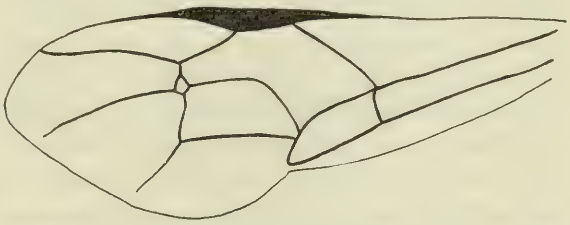
FIG. 62.— Parabates memorialis, sp. nov. Type.

One specimen, collected by Professor Cockerell, no station indicated on the slab. No. B3, type in the Museum of the University of Colorado.

This is a typical paniscine which looks very much like our living North American species of Opheltes in habitus and color. Structurally it comes closer to Parabates in which genus I have placed it.

OPHELTES Holmgren.

There is a specimen, No. 2375, M. C. Z., Florissant, Col. (No. 4680, S. H. Scudder Coll.) which appears to belong to Opheltes or some closely allied genus. As it is not very well preserved I have not described it. The size is rather small, about 8 mm.

The tribe Banchini is represented in the collection by one species referable to the genus Lapton and a second one belonging to Exetastes.

LAPTON DAEMON, sp. nov.

Sex? Length 9 mm. Body dark colored, the abdomen beyond the base of the second segment more or less ferruginous; four anterior legs fusco-ferruginous; hind pair darker, with honey-yellow trochanters. Antennae slender, the basal joints very long, the first flagellar joint being about five and the second about four times as long as wide; following growing shorter, those toward the apex becoming quadrate. Thorax very finely punctulate or shagreened; metanotum completely areolated. Abdomen long and slender, gradually thickened apically; first segment slightly but evenly curved, as long as the metanotum; its spiracles placed at about the basal third; second segment nearly as long as the first and stouter; following stouter, all more or less distinctly blackened basally. Legs long and slender, first three joints of posterior tarsus about as long as the tibia. Wings hyaline; stigma and veins pale fuscous. Stigma lanceolate. Marginal cell long, the first section of the radius less than one-half as long as the second. Discocubital cell rather long, the discocubital vein slightly and evenly curved; transverse cubitus long and strongly oblique, its base being nearer the base of the wing; recurrent nervure received far beyond it, also strongly oblique, but in an opposite sense; second discoidal cell broad at the base; median and submedian cells seemingly of equal length; transverse median vein in hind wing apparently broken near the middle.

Type.— No. 2269, M. C. Z., Florissant, Col. (No. 8148, S. H. Scudder Coll.).

This species most surely belongs to the Banchini and apparently comes closest to Lapton, although unfortunately the mouthparts and the transverse median vein of the front wings are not preserved.

EXETASTES INVETERATUS, sp. nov. (Fig. 63.)

Female. Length 7 mm. Very dark colored, the abdomen except at the base much lighter. Rather stout, the head thin antero-posteriorly. Antennae long and slender, brown, the joints of the flagellum toward the base about twice as long as wide. Mesonotum minutely punctulate; metathorax not areolated, although there are some slight irregular indications of carinae. Abdomen stout, contracted sharply at the base, but not petiolate; first segment three-fourths as long as the second; third and fourth together as long as the second, fifth and sixth smaller. Ovipositor two-thirds as long as the abdomen, black. The abdomen is smooth except the first segment which is quite distinctly although delicately punctured. Wings hyaline; stigma and veins fuscous; areolet large, quadrangular, oblique, subsessile above; marginal cell broad, sharply pointed apically, the second section of the radius about two and one-half times as long as the first; stigma large, subtriangular; discocubital vein sharply bent, but without trace of a stump of a vein; submedian cell considerably longer than the median.

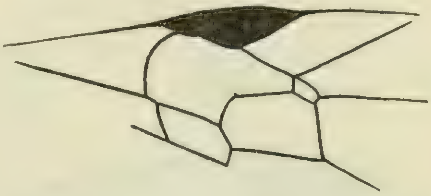

FIG. 63.— Exetastes inveteratus, sp. nov. Type.

Type.— No. 2270, M. C. Z., Florissant, Col. (No. 7512, S. H. Scudder Coll.).

This species resembles in superficial appearance some of the species of Mesochorus described in the present paper, but differs by the much more sessile attachment of the abdomen and by the convex, non-areolated metathorax.

A considerable series of species occur at Florissant, seven in all, which I have placed provisionally in the genus Mesochorus although they are not very typical. In all of them the areolet is much smaller than in recent forms, but otherwise they are quite similar.

A very typical species of Mesochorus has been described by Scudder ('90) from the Oligocene of Green River, Wyoming, but by him made the type of a new genus, Lithotorus. Brischke ('86) also records the probable presence of Mesochorus in Baltic Amber.

MESOCHORUS Gravenhorst.

Key to the Florissant species of Mesochorus.

1. Areolet large, distinctly sessile above . . . . 2.
   Areolet petiolated or subpetiolated above; last section of the radius not recurved (i. e. convex on side toward costal margin of wing). 3.

2. Large species, length 8.5 mm., last section of the radius recurved. *M. lapideus*, sp. nov.
Smaller, less than 6 mm., last section of the radius straight. *M. carceratus*, sp. nov.
3. Petiole of areolet long, nearly as long as the inner side of the areolet, stigma narrow . . . . . . *M. abolitus*, sp. nov.
Petiole shorter or obsolete . . . . 4.
4. Stigma slender, lanceolate . . . . 5.
Stigma ovate or broadly ovate . . . . 6.
5. Areolet distinctly petiolate, the petiole distinct. *M. revocatus*, sp. nov.
Petiole obsolete . . . . 7.
6. First section of the radius much longer than the thickness of the stigma . . . . *M. terrosus*, sp. nov.
First section of the radius not or scarcely longer than the thickness of the stigma . . . . *M. cataclysmi*, sp. nov.
7. Areolet regularly rhombic . . . . *M. aboriginalis*, sp. nov.
Areolet rhomboidal, distinctly oblique. *M. dormitorius*, sp. nov.

Mesochorus lapideus, sp. nov. (Fig. 64.)

Female. Length about 8.5 mm. Brown, varied with darker; wings hyaline. Head probably black; antennae fuscous, about 32-jointed, rather stout, the basal flagellar joints about three times as long as thick; those toward the apex quadrate. Thorax brownish or blackish, varied on the pleurae with lighter. Metanotum areolated, the basal and middle lateral areas separated, but indistinctly so. Abdomen brown or ferruginous, the petiole and spot at base of second segment black. Ovipositor short, slightly curved downward at the tip. Coxae and legs black, tarsi light brown, with darker tips. Marginal cell long and narrow, the last section of the radius curved inwardly so that it bulges into the marginal cell; fully three times as long as the first section. Stigma lanceolate, but moderately broad. Areolet large, obliquely rhomboidal, quite broadly sessile above; submedian cell longer than the median.

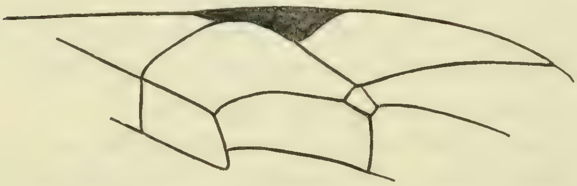

Fig. 64.— Mesochorus lapideus, sp. nov. Type.

Type.— No. 2276, M. C. Z., Florissant, Col. (No. 11,421, S. H. Scudder Coll.).

MESOCHORUS CARCERATUS, sp. nov. (Fig. 65.)

Female. Length 6 mm. Black, the abdomen except at the base, more or less brownish or ferruginous. Antennae piceous, short and stout, the basal flagellar joints only about two times as long as thick; those beyond the middle quadrate. Metanotum regularly areolated, the basal and middle lateral areas completely separated. Basal segment of abdomen black; the second segment pale ferruginous; following growing gradually darker to the tip which is fuscous. Ovipositor long, nearly as long as the body, but this seems to be due in great part to pressure, all the terminal segments being strongly extruded. Legs black, the knees lighter. Wings subhyaline, stigma and veins piceous; the former rather broad, subtriangular; marginal cell short, the radius sharply angled, its second section straight, twice as long as the first. Areolet rather large, obliquely rhomboidal and broadly sessile above. Submedian cell very slightly longer than the median; discocubital cell shorter than usual.

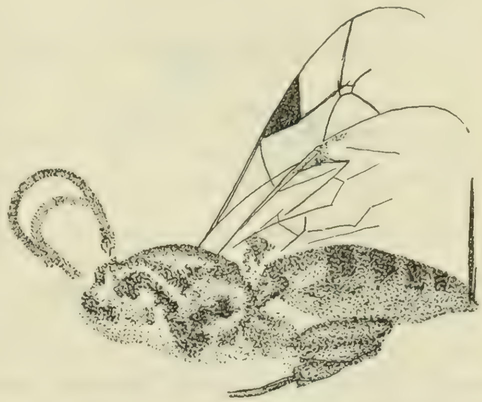

FIG. 65.— Mesochorus carceratus, sp. nov. Type.

Described from one specimen sent by Professor Cockerell, No. A15. Type in the Amer. Mus. Nat. Hist.

MESOCHORUS ABOLITUS, sp. nov. (Fig. 66.)

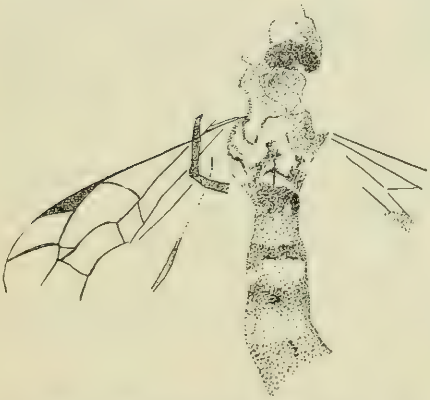

FIG. 66.— Mesochorus abolitus, sp. nov. Type.

Sex? Length probably 8 or 10 mm. A specimen only in part preserved, but with both anterior wings in good condition. The color of the head and thorax is dark, with the abdomen lighter and distinctly banded with blackish on each segment anteriorly. Antennae rather long, the joints toward the apex of the flagellum broad, quadrate or slightly transverse. The wings are hyaline, with fuscous stigma and veins; stigma lanceolate, but nevertheless rather broad, with its inferior margin distinctly angled; marginal cell long, the second section of the radius straight, less than twice as long as the first. Areolet with a long petiole, obliquely rhomboidal; discocubital cell long; submedian cell considerably longer than the median.

Described from one specimen sent by Professor Cockerell, No. A66. Type in the Amer. Mus. Nat. Hist.

MESOCHORUS REVOCATUS, sp. nov. (Fig. 67.)

Length probably about 8 mm., although only part of the head and thorax and the wings are preserved. The metanotum is regularly areolated, with the basal and middle lateral areas separated. The wings are hyaline, with fuscous veins and stigma. Stigma long, lanceolate. Marginal cell moderately long, the second section of the radius straight, twice as long as the first; areolet moderately large, with a long petiole above; obliquely rhomboidal in form; discocubital cell short, the submedian cell scarcely longer than the median. General color of body black.

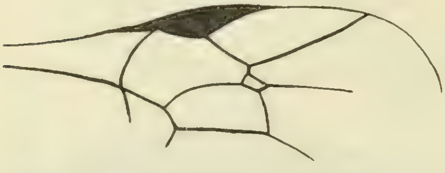

FIG. 67.— Mesochorus revocatus, sp. nov. Type.

Type.— No. 2277, M. C. Z., Florissant, Col. (No. 14,494, S. H. Scudder Coll.).

MESOCHORUS TERROSUS, sp. nov.

Female. Length 6.5 mm. Black; antennae and abdomen beyond the second segment, brown. Head small, antennae long and slender, the basal flagellar joints four or five times as long as thick. Metanotum regularly areolated, the basal and middle lateral areas completely separated. Abdomen clavate, the petiole stout, curved above but straight below, as long on its dorsal surface as the second segment; third to sixth segments gradually higher dorsoventrally, but of about equal length. Ovipositor distinctly exserted, its sheaths broad. Legs slender, brown or dark ferruginous, the tips of the hind tibiae and the hind tarsi blackish. Wings hyaline; stigma and veins ferruginous; marginal cell long, its second section straight, more than twice as long as the first which is curved and longer than the thickness of the stigma. Areolet moderately large; obliquely rhomboidal, subpetiolate above; discocubital cell short, the discocubital nervure very sharply bent downward basally; submedian cell very slightly longer than the median.

Type.— No. 2278, M. C. Z., Florissant, Col. (S. H. Scudder Coll.).

MESOCHORUS CATACLYSMI, sp. nov. (Fig. 68.)

Female. Length 5–7 mm. More or less brownish, the head and thorax darker and the abdomen darker on the apical parts of the segments. Legs light brown or yellow; hind pair, except coxae, trochanters and base of tibiae blackish. Antennae rather stout, imperceptibly thickened toward the tips; basal joints of flagellum about three times as long as thick, the apical ones quadrate; they are about 23-jointed. Mesonotum quite distinctly punctulate; metanotum regularly and completely areolated. Abdomen clavate; petiole long and slightly curved both above and below, fully one-fourth longer than the second segment; third to fifth growing higher, but shorter. Ovipositor as long as the first and second abdominal segments together. Wings small, hyaline, with fusco-ferruginous stigma and veins. Stigma very broad, triangular. Marginal cell short and broad, the second section of the radius straight, very oblique, and fully four times as long as the first which is no longer than the thickness of the stigma; discocubital cell short, the discocubital vein strongly but evenly curved; median and submedian cells of equal length. Areolet rather small, subsessile, long oblique, but tending to be rectangular. Legs slender.

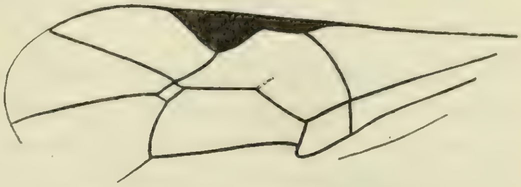

Fig. 68.— Mesochorus cataclysmi, sp. nov.

Type.— No. 2279, M. C. Z., Florissant, Col. (No. 13,788, S. H. Scudder Coll.). In all there are four specimens before me; the type, Nos. 2280–2281, M. C. Z., Florissant, Col., Nos. 9678 and 8945, (Fig. 68) Scudder Coll., and No. A67 collected by Professor Cockerell at Station 17.

Mesochorus aboriginalis, sp. nov. (Fig. 69.)

Female. Length 5–6 mm. Black, or dark colored, the abdomen beyond the base of the second segment reddish brown. Legs so far as preserved brownish beyond the coxae. Head seen in lateral aspect smooth, but seemingly not polished; mesonotum like the head, but with a few transverse wrinkles anteriorly; pleurae delicately sculptured, more or less obliquely or irregularly wrinkled. Metathorax areolated, the areas smooth, slightly rugose apically. Abdomen about one and one-half times as long as the thorax, petiolate, the petiole three-fourths the length of the posterior slope of the metathorax, gradually and slightly thickened apically; remainder of abdomen subclavate, the second segment three-fourths the length of the first; third only two-thirds the length of the second; fourth and fifth gradually shorter. Ovipositor about as long as the

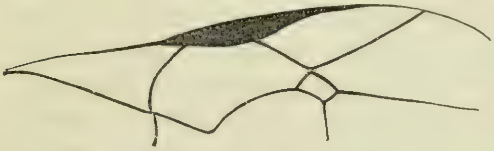

Fig. 69.— Mesochorus aboriginalis, sp. nov. Type.

first and second abdominal segments combined, very stout and blunt at the apex. Wings hyaline, veins and stigma fuscous. Stigma long, narrowly lanceolate, the radius originating beyond its middle; marginal cell moderately long, acute at the tip, the second section of the radius twice as long as the first. Submedian cell distinctly longer than the median. Areolet large, regularly rhombic; discocubital and basal veins strongly arcuate.

Type.— No. 2282, M. C. Z., Florissant, Col. (No. 6325, S. H. Scudder Coll.).

This species is more like recent ones than the foregoing ones on account of the large rhombic areolet, the very typical abdomen and ovipositor. It appears to be more like *Mesochorus* (*Lithotorus*) *cressoni* Scudder from Green River, Wyoming, than any of the other Florissant species.

MESOCHORUS DORMITORIUS, sp. nov. (Fig. 70.)

Female. Length 6.5 mm. Black; prothorax, line before tegulae, tegulae and legs including all coxae yellowish or reddish brown; the tibiae and tarsi of the hind pair much darker. Abdomen below toward the apex brownish. Antennae slender, with something over 30 joints, the ones near the apex but little longer than thick; those near the base three or four times as long as thick, the first flagellar still longer. Mesonotum finely shagreened; metathorax completely and distinctly areolated. Abdominal petiole seen from the side a little shorter than the posterior face of the metathorax, weakly arcuate and thickened apically from near the base. Apical abdominal segments strongly compressed, but this is probably in part due to flattening within the rock. Ovipositor at least as long as the first two abdominal segments, and probably longer as its apex is lost; its sheaths but slightly flattened. Wings slightly infuscated. Stigma piceous; veins fuscous; marginal cell about three and one-half times as long as its greatest height; first section of the radius slightly less than one-half as long as the second; areolet large, obliquely rhomboidal, the first transverse cubitus two-fifths as long as the first section of the radius. Stigma not especially broad, more lanceolate.

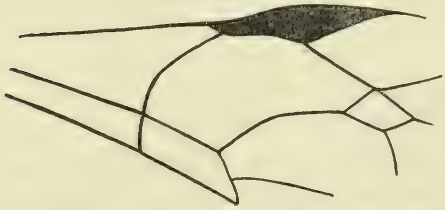

FIG. 70.— Mesochorus dormitorius, sp. nov.

Type.— Nos. 2283–2284, M. C. Z., Florissant, Col. (No. 13,778 and 13,826 (reverse), S. H. Scudder Coll.). The Scudder Collection also contains a specimen, Fig. 70 (No. 11,970, M. C. Z., 2265) which I refer to this species.

A typical Mesochorus, except that the abdomen appears to be more flattened than usual near the tip.

Of the numerous genera included in the Porizonini, only one, Porizon, has been found fossil, one species by Brischke ('86) in Baltic Amber, and a second among the present material.

PORIZON EXSECTUS, sp. nov. (Fig. 71.)

Length 6 mm. Head and thorax nearly black, abdomen brownish yellow, the petiole fuscous. Legs pale brown, the hind pair somewhat darker. Wings hyaline. Head and thorax very finely punctulate, the metanotum areolated; petiole of abdomen one-half as long as the thorax, tip of abdomen not preserved. Wings with a large, almost triangular stigma; first section of the radius distinctly less than half as long as the second which meets it at a right angle; transverse cubitus oblique, almost a continuation of the first section of the radius, interstitial with the recurrent nervure below; median and submedian cells of equal length; marginal as long as the discocubital cell.

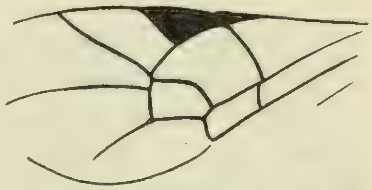

FIG. 71.— Porizon exsectus, sp. nov. Type.

Type.— No. 2286, M. C. Z., Florissant, Col. (No. 3223, S. H. Scudder Coll. The specimen shows the head, thorax, both front wings, and the basal part of the abdomen, and there can be no doubt that it is a true Porizon.

So far no representatives of the Pristomerini have been found in a fossil state.

DEMOPHORUS ANTIQUUS, sp. nov. (Fig. 72.)

Female. Length 6.5–7 mm. Color probably dark or brownish, the tips of the hind femora darker and the head black. Antennae long, slender, involute, of equal thickness throughout; more than 30-jointed, the joints of the apical portion about quadrate, those nearer the base of the flagellum longer. Thorax almost evenly arcuate above when seen from the side; the metathorax rather sharply declivous behind, regularly and completely areolated. Abdomen compressed strongly toward the apex; petiole long, slender, straight, but little thickened on its apical three-fifths; second segment about as long as the first, twice as high at its tip as at the base. Legs stout, especially the posterior femora, which are much thickened, but apparently without any teeth below near the apex. Wings hyaline or nearly so, stigma and veins piceous. Stigma large, broadly triangular, emitting the radius somewhat beyond the middle. Costal margin thickened at the insertion of the basal nervure; first and second sections of the radius meeting at an oblique angle; both straight, the second three times the length of the first. Areolet rather small, oblique, in the form of an elongate, inverted trapezoid; median and submedian cells of equal length.

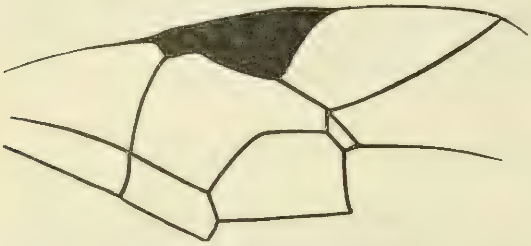

Fig. 72.— Demophorus antiquus, sp. nov. Type.

Type.— No. 2287, M. C. Z., Florissant, Col. (No. 13,869, S. H. Scudder Coll.). Also No. 2288, M. C. Z., Florissant Col. (No. 11,699, S. H. Scudder Coll.).

This seems to belong to Thomson's genus Demophorus, known hitherto by two recent species from Europe. The thickened hind femora suggest a possible relationship with Pristomerus and its allies, but I can detect no teeth on them, upon which character the recognition of these genera principally depends.

ALYSIIDAE.

Up to the present time this family has not been recognized in the fossil state, but the present collections contain two species which undoubtedly belong here.

Although easily distinguished by their peculiarly attached mandibles from the Braconidae, particularly the subfamily Aphidiinae which they resemble in venation, members of the family are not easily recognizable in the fossil state. This is due to the fact that the form and insertion of the mandibles are usually very difficult to make out unless the preservation of the specimens is unusually good. Both of the new species belong to the genus Alysia *sensu lato*.

Alysia Latreille.

Key to the Florissant species of Alysia.

1. First section of the radius less than one-half as long as the second; third section straight . . . . *A. petrina*, sp. nov.
First section of the radius considerably more than one-half as long as the second; third section distinctly arcuate.
A. exigua, sp. nov.

ALYSIA PETRINA, sp. nov. (Fig. 73.)

Female. Length 5 mm. Ovipositor about 2 mm. Black or piceous, the abdomen, except apex reddish or brownish. Anterior legs reddish; middle and posterior pairs piceous or black. Specimen partly seen in ventral view, the head greatly widened behind; the large, externally arcuate mandible on one side showing very distinctly. Body behind the scutellum showing the dorsal view (i. e. the specimen split off to the dorsal wall). Metathorax distinctly rugose-reticulate. Abdomen as long as the head and thorax together; subpetiolate; first segment gradually widened from the base to the apex which is a little less than one-half as wide as long. Second segment as long as the first, but much wider than long; following together as long as the first two; apex obtusely pointed. Ovipositor preserved to a distance nearly equal to the length of the abdomen and possibly still longer. Legs moderately slender. Wings long and rather narrow, stigma and veins fuscous, the former short and broad, subtriangular. Radial cell long, almost attaining the wing tip, the first section of the radius less than one-half as long as the second. Three cubital cells, the second short, its inner side one-half longer than its upper. Recurrent nervure interstitial with the transverse cubitus; submedian cell as long as the median; discoidal nervure broken below the middle.

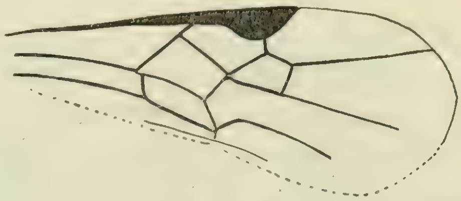
FIG. 73.— Alysia petrina, sp. nov. Type.

Type.— No. 2289 M. C. Z., Florissant, Col. (No. 8812, S. H. Scudder Coll.).

ALYSIA EXIGUA, sp. nov. (Fig. 74.)

Length 5 mm. Yellow or light colored, the tips of the mandibles, antennae, tarsi, and tips of posterior tibiae, black or blackish. The head and entire body are seen in ventral aspect. The mandibles are very large and prominent. Antennae slender, with more than twenty joints, their tips not being shown in the specimen; the joints near the base are from four to three times as long as thick, those nearer the apical portion becoming somewhat shorter. Legs rather long and stout, the posterior tibiae with a pair of long apical spurs. Wings long, hyaline, the veins very slender and weakly colored. Stigma ovate, rather

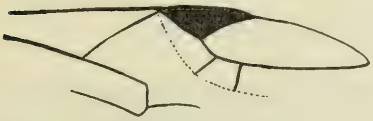
FIG. 74.—Alysia exigua, sp. nov. Type.

broad; marginal cell long and rather broad. From the contour of the radius there were probably three submargial cells, although the second transverse cubitus is obliterated in the specimen.

Type.— No. 2290, M. C. Z., Florissant, Col. (No. 4380, S. H. Scudder Coll.).

The type is rather poorly preserved.

BRACONIDAE.

This extensive family is not nearly so well represented in the collections from Florissant as is the Ichneumonidae, but this I believe is in great part due to the fact that a larger percentage of the specimens belonging here are but poorly preserved. From a count of specimens belonging definitely to one or the other of these families it is seen that the disparity in numbers is not so great as one might suspect from a comparison of the number of species I have described in each. The probable reasons for so many poorly preserved braconids have been suggested on a previous page.

The number of references by earlier writers is also quite limited, and aside from the Florissant material which I have studied, only four or five genera have been found fossil, Macrocentrus, Chelonus, Agathis, Bracon, and possibly Hormiopterus. In the Florissant fauna I have been able to recognize thirteen, several of them represented by more than one species.

The genus Calyptites described by Scudder from Quesnel, B. C., is undoubtedly an ant, the presence of a large costal cell in the wing described by Scudder at once removes the species from this family, and the venation is typically ant-like.[1]

EUPHORINAE.

EUPHORUS INDURESCENS, sp. nov. (Fig. 75.)

Probably a female. Length 3 mm. Entirely brown or dark colored, with the legs distinctly lighter. Head globose, smooth and polished on the front and vertex, except for some coarse transverse rugae near the base of the antennae. Antennae distinctly thickened toward the tips, nearly as long as the

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[1] Prof. W. M. Wheeler has very kindly examined Scudder's figure and confirms (:08) my opinion that the species belongs to the Formicidae.

body; basal joints elongate; those near the middle quadrate and those toward the apex moniliform; the tips not preserved, but there were probably a few more than 20 joints. Thorax and abdomen seen in ventral view, the former ovate, distinctly less than two times as long as wide. Abdomen elongate ovate, with a stout, short petiole, the second segment more than four times as long as those following it combined. Wings not preserved. Legs slender.

Type.— No. 2336, M. C. Z., Florissant, Col. (No. 6620, S. H. Scudder Coll.).

One specimen, not showing many diagnostic characters, but without doubt a member of the Euphorinae and the first fossil member of the subfamily to be described. It resembles a belytid superficially, but there are too many joints to the antennae. This same resemblance is seen in recent forms, although it is of course entirely superficial.

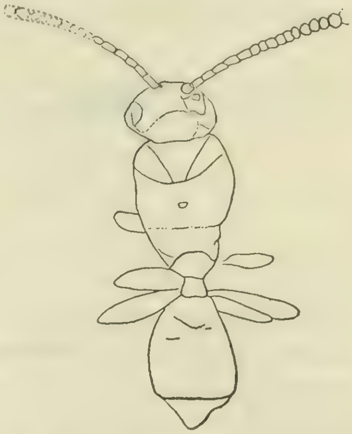
FIG. 75.— Euphorus indurescens, sp. nov. Type.

MACROCENTRINAE.

I have found no representatives of this group in the Florissant material, but Macrocentrus has been recorded from Baltic Amber by Brischke ('86).

HELCONINAE.

Two genera, Diospilus and Dyscoletes occur at Florissant, and are the first members of this subfamily to be found in the fossil state.

DIOSPILUS REPERTUS, sp. nov. (Fig. 76.)

Female. Length 4.75 mm. Black, the abdomen brown or piceous, legs ferruginous or yellowish brown. Antennae a little shorter than the body, about 30-jointed, slender and of even thickness. Surface of head and thorax smooth and shining; metathorax distinctly areolated and more or less distinctly granulated on the surface. Abdomen stout, swollen, about as long as the head and thorax together; second and third segments subequal, the longest; others about two-thirds as long and subequal among themselves.

Ovipositor not preserved, but it is distinct enough showing through the last abdominal segment to indicate that the specimen is a female. Wings slightly but quite evidently tinged with fuscous; stigma and veins fuscous, the former ovate, rather broad, the radius issuing far beyond the middle. Marginal cell rather long and acutely pointed at apex; first discoidal cell not petiolate above; submedian cell slightly longer than the median; second section of the radius nearly twice as long as the first and about as long as the second transverse cubitus; recurrent nervure inserted considerably before the tip of the first cubital cell; inner and lower sides of the second cubital cell about equal, each longer than the two other sides which gives it the form of an oblique trapezoid; second discoidal cell closed at the tip, the subdiscoidal vein inserted far below the middle of the discoidal vein.

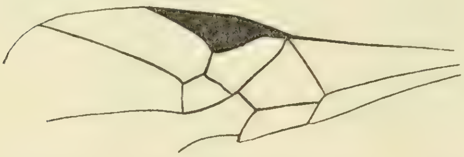

Fig. 76.— Diospilus repertus, sp. nov. Type.

Type.— No. 2337–2338, M. C. Z., Florissant, Col. (No. 3411 and 7339 (reverse) S. H. Scudder Coll.).

The proper place to assign to this and the following species still remains in doubt and although they show some characters which might suggest the Macrocentrinae or even the Rhogadinae, I believe that both belong in the Helconinae. It is hardly to be hoped that specimens will be found showing the occipital margin or other characters necessary for a positive diagnosis, so I have ventured to describe them in the present somewhat problematic position.

A specimen later received from Professor Cockerell shows that the ovipositor is quite long, at least nearly equalling the abdomen, and in its habitus confirms my opinion that the species properly belongs here.

DYSCOLETES SOPORATUS, sp. nov. (Fig. 77.)

Female. Length 4.5 mm. Pale yellowish brown, the antennae and upper part of the head darker. Head and thorax smooth and shining. Antennae about as long as the body, slender and tapering near the tip, with about 30 or possibly a larger number of joints; those near the base long, four or five times as long as thick, but the apical ones very much shortened; those near the extreme tip rounded and almost moniliform. Metanotum at least partially areolated. Abdomen ovate, broadly sessile, the second segment the longest, but the others nearly as long, growing very gradually shorter to the tip. Ovi-

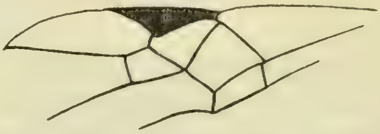

Fig. 77.— Dyscoletes soporatus, sp. nov. Type.

positor exserted, but broken off about one millimeter from its base. Wings hyaline, the stigma and venation pale yellowish brown, the former rather broad, ovate, giving off the radial vein at its middle; marginal cell long, lanceolate; first discoidal cell distinctly petiolate; second cubital cell strongly narrowed above, its radial side only one-half as long as the cubital one. Recurrent nervure and first transverse cubitus interstitial, forming a straight line; second discoidal cell completely closed; discoidal vein broken very near the bottom; submedian cell distinctly longer than the median.

Type.— No. 2339, M. C. Z., Florissant, Col. (No. 13,360, S. H. Scudder Coll.).

This species reminds one both in form and color of certain species of Macrocentrus, but the short, high, second submarginal cell which is much contracted above does not agree with that genus. Unfortunately as is almost always the case, cephalic, thoracic, and pedal characters are not well enough preserved to permit of its positive location in any tribe, and the present generic reference can be considered as provisional only.

BLACINAE.

The following species of Calyptus is the only fossil species to be described in this group.

CALYPTUS WILMATTAE, sp. nov. (Fig. 78.)

Female. Length 4 mm. Ovipositor at least 2.5 mm. Dark colored, probably piceous or fuscous, the anterior part of the thorax below and the basal part of the abdomen lighter, more yellowish. Abdomen slightly longer than the head and thorax together, apparently gradually narrower from beyond the middle to the sessile base. Wings hyaline, or very slightly tinged with brownish; stigma and veins fuscous, the latter oval, only moderately broad, the radius originating beyond its

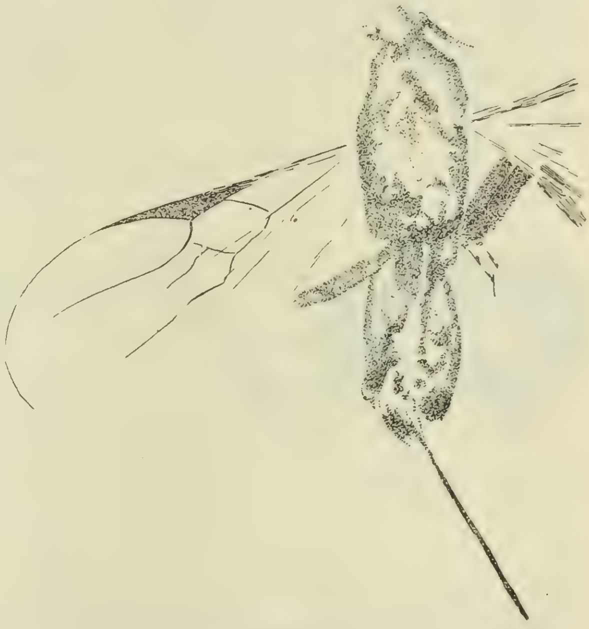

FIG. 78.— Calpytus wilmattae, sp. nov. Type.

middle. First discoidal cell sessile above; recurrent nervure parallel with the first transverse cubitus, received near the tip of the first cubital cell; marginal cell long, the radius strongly arcuate at the base, but nearly straight beyond; submedian cell considerably longer than the median; second discoidal cell completely closed; subdiscoidal vein inserted below the middle of the discoidal vein; anal cell apparently not divided. There is a constriction beyond the first transverse cubitus as though a second transverse cubitus were present, but in both otherwise finely preserved wings there is no trace of such nervure.

Described from one specimen collected by Mrs. W. P. Cockerell at Station 13B. It has very well preserved wings, although the body which is seen in ventral view shows few details. I cannot be positive that this is the proper location for the species, but I think it will be sought for in this group.

SIGALPHINAE.

No Sigalphinae are known to occur in other formations, and only one which is probably referable to Urosigalphus occurs at Florissant.

UROSIGALPHUS AETERNUS, sp. nov. (Fig. 79.)

Probably a female. Length 2 mm. Entirely black except for the tip of the abdominal carapace below, which is dark fuscous or piceous. Antennae very slender, of an indeterminate number of joints as the apices are not preserved; basal joints elongate, but those farther on (beyond the middle) quadrate and distinctly thicker than the basal ones. Surface of head and mesonotum shining, the pleurae below slightly and the abdominal carapace strongly rugose punctate in the manner characteristic of members of the subfamily. Abdomen very short and stout, scarcely longer than the head and thorax together, both of which are also stout. Wings nearly hyaline; stigma fuscous, veins pale brown; Radial vein originating just beyond the middle of the stigma, the radial cell short, ovate; two cubital cells, the first receiving the recurrent nervure at a distance before the tip equal to the length of the first section of the radius. Submedian vein not preserved.

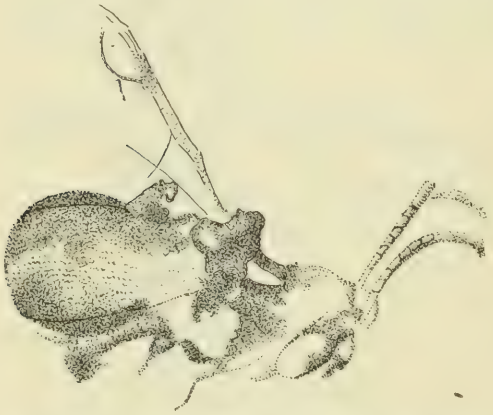

FIG. 79.— Urosigalphus aeternus, sp. nov. Type.

One specimen and reverse, collected by Mr. S. A. Rohwer at Station 13. Type in the Amer. Mus. Nat. Hist.

This is quite a characteristic member of the Sigalphinae, but may not be a true Urosigalphus, since the length of the submedian cell cannot be determined.

CHELONINAE.

Both Gravenhorst ('35) and Brischke ('86) have found Chelonus in Baltic Amber, and the material which I have from Florissant contains three species of this same genus.

CHELONUS Jurine.

Key to the Florissant species of Chelonus.

1. Abdomen strongly longitudinally aciculated, wings infuscated. *C. muratus,* sp. nov.
   Abdomen coriaceous, or irregularly rugose, wings hyaline or nearly so . . . . 2.
2. Pleurae very coarsely rugose . . . . . . *C. solidus,* sp. nov.
   Pleurae only slightly rugulose, smooth below. *C. depressus,* sp. nov.

CHELONUS MURATUS, sp. nov. (Fig. 80.)

Length 3.5 mm. Small, black or dark colored, the abdomen lighter below. Antennae rather long, of the usual form, about 30-jointed, the joints becoming very short toward the apex. Flagellum brown, scape black. Head finely lineately rugose or aciculate. Thorax finely rugulose or coriaceous, the pleurae

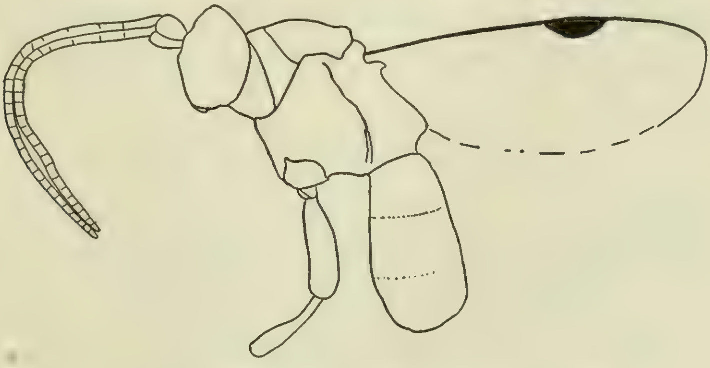

FIG. 80.— Chelonus muratus, sp. nov. Type.

below more coarsely so and the metanotum rugose reticulate. Abdomen without any indications of sutures, elongate oval, rather more slender than usual, its thickest portion scarcely beyond the middle; its surface longitudinally aciculate with occasional reticulations. Legs, or at least the posterior femora dark in color. Wings rather strongly infuscated.

Type.— No. 2341, M. C. Z., Florissant, Col. (No. 9150, S. H. Scudder Coll.).

The type is not very well preserved, but is evidently specifically distinct from the other specimens of Chelonus in the collection.

CHELONUS SOLIDUS, sp. nov. (Fig. 81.)

Length 4.5 mm. Dark colored or black, the antennae including the scape light brown. Head finely rugulose, but not at all aciculated. Antennae not preserved at the tip, but their basal portion is apparently normal. Mesonotum rather finely rugose or coriaceous, the pleurae very coarsely rugose, especially below. Metanotum not visible as the legs are extended directly above it. Abdomen obovate, the thickest part near the tip; no traces of any transverse sutures. Its surface finely rugose reticulate as is usual in the genus. Wings hyaline, the stigma and veins dark. Venation not well enough indicated to describe.

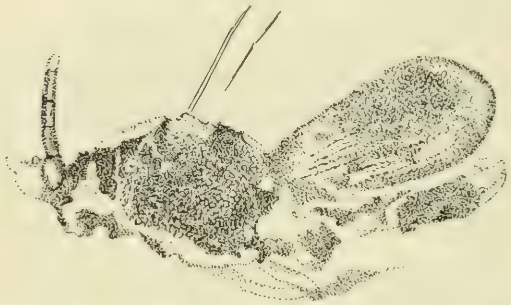

FIG. 81.— Chelonus solidus sp. nov. Type.

One specimen, No. A126, collected by Mr. S. A. Rohwer at Station 14. Type in the collection of the Amer. Mus. Nat. Hist.

CHELONUS DEPRESSUS, sp. nov.

Female? Length 4–4.5 mm. Color black or very dark, the antennae, and the legs, except the posterior femora and tibiae rather light brown. Antennae two-thirds as long as the body, about 25–30-jointed, setaceous, the small joints toward the apex quadrate-moniliform, and the larger basal joints from two to three times as long as thick; scape globose. Body rather strongly sculptured. Face confluently punctate, the front above, and the vertex also to some extent, transversely rugose. Pleurae slightly rugulose above, smooth below except along the sutures. Metanotum rugose, with reticulations posteriorly which form a series of more or less distinct small areas. Abdomen coriaceous or rugulose, without traces of any sutures. Short, only as long as the thorax, elongate oval when seen from the side, the margin evenly rounded at the tip when seen from the side and rather pointed when seen from above. Wings hyaline, stigma large, light brown, venation almost effaced, but apparently identical with that of recent representatives of the genus.

Type.— No. 2342, M. C. Z., Florissant, Col. (No. 2077, S. H. Scudder Coll.). Nos. 2343–2344, M. C. Z., Florissant, Col. (Nos. 1917 and 5236, S. H. Scudder Coll.) also belong to this species. The Scudder Collection also contains two specimens (No. 11,404, M. C. Z., No. 2345, and No. 13,815, M. C. Z., 2346) which I doubtfully refer to this species.

AGATHIDINAE.

Serres, ('**29**) has recorded Agathis from Aix in the Lower Oligocene, and the Florissant beds have yielded the three species described below.

AGATHIS Latreille.

Key to the Florissant species of Agathis.

1. Second cubital cell (areola) small, strongly narrowed above or triangular, species small, 3.5–5 mm. . . . . 2.
   Areola large, scarcely narrowed above, its upper side longer than the first section of the radius, large species, 7 mm. *A. saxatilis*, sp. nov.
2. Areola triangular, touching the radius in a point, the second transverse cubitus hyaline, indistinct . *A. velatus*, sp. nov.
   Areola with a distinct upper side, although this is much shorter than the first section of the radius, second transverse cubitus fully colored . . . . *A. juvenilis*, sp. nov.

AGATHIS SAXATILIS, sp. nov. (Fig. 82.)

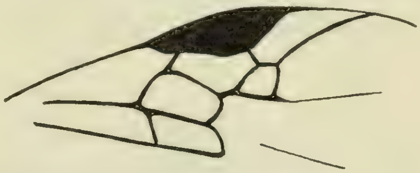
FIG. 82.— Agathis saxatilis, sp. nov. Type.

Length 7 mm. Probably dark colored or black. Antennae black, rather long and tapering, the joints near the base a little less than twice as long as thick, those toward the apex much smaller, but as long in proportion to their width. Surface of head smooth and polished. Thorax seen in dorsal view likewise shining, the sutures crenulate; metanotum with traces of a more or less distinct areolation. Abdomen somewhat lighter than the head and thorax, particularly at the base which was perhaps reddish or brownish in life. Wings apparently slightly infuscated, the veins very dark and heavy as usual in the genus. Stigma rather large, ovate, the lower edge strongly convex. Marginal cell short and narrow, its first section distinctly shorter than the second; third slightly bowed into the radial cell. Submedian cell slightly longer than the median; recurrent nervure at the apical fourth of the first cubital cell; first discoidal cell with a petiole above as long as the first section of the radius; second cubital cell larger than usual, distinctly quadrate, being but slightly narrowed above. Cubitus beyond the second transverse cubitus present but weak.

Described from one specimen, not very well preserved, except the anterior wings which serve to indicate its affinities without the least doubt.

Type.— No. 2348, M. C. Z., Florissant, Col. (No. 770, S. H. Scudder Coll.).

AGATHIS VELATUS, sp. nov. (Fig. 83.)

Female. Length 5 mm. Head and thorax black, abdomen brownish red, paler basally. Antennae about 25–35-jointed; not much tapering as they are rather slender near the base; joints toward the base of the flagellum two to two and one-half times as long as thick; those near the apex much shorter, quadrate or nearly so. Head, mesonotum, and pleurae smooth and shining; metathorax with a few raised reticulate lines. Legs apparently light colored, except the posterior coxae and tarsi which are black. Ovipositor as long as the abdomen. Wings hyaline, the stigma and veins light brown. Stigma rather large, broad. Marginal cell very narrow, the second section of the radius rather strongly curved inwardly; second cubital cell small, triangular, its inner side strongly oblique, its outer one weak, nearly hyaline, only slightly slanting.

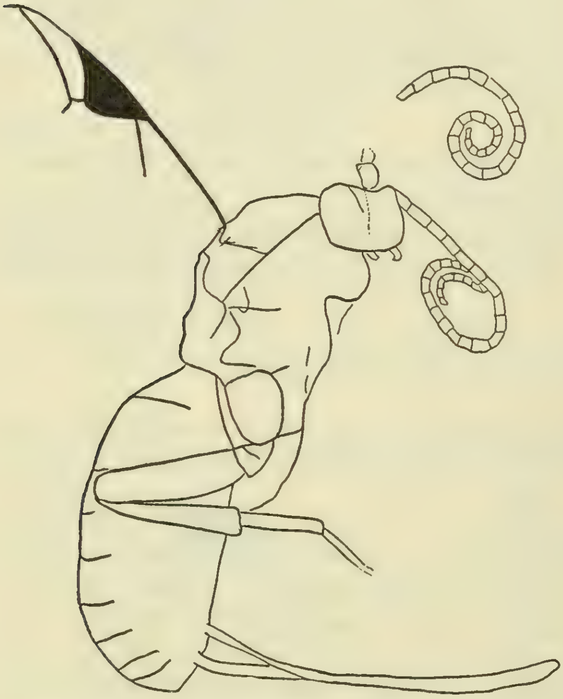

FIG. 83.— Agathis velatus, sp. nov. Type.

Type.— No. 2349, M. C. Z., Florissant, Col. (No. 5339, S. H. Scudder Coll.). There is also a second specimen, No. 2350 M. C. Z., Florissant, Col. (No. 2509, Scudder Coll.) which is perhaps the same species. The body of the type is seen in lateral view and is rather well preserved. Of the wings only the radial cell and the second cubital are preserved, but these serve to show characters peculiar to this group.

AGATHIS JUVENILIS, sp. nov. (Fig. 84.)

Female. Length 3–3.25 mm. Black, with the abdomen light brownish yellow or reddish. Antennae short, slender, involute, of nearly equal thickness throughout, the joints near the base of the flagellum about one and one-half times as long as thick, and those toward the tip a trifle shorter. Head and entire thorax, including pleurae, shining. Ovipositor one and one-half times as long as the abdomen. Wings hyaline, or slightly yellowish, stigma and veins pale fuscous. Stigma very broad and short; marginal cell narrow, the third section of the radius very slightly bent inward. Second cubital cell of medium size, with a distinct upper side, which is, however, much shorter than the first section of the radius.

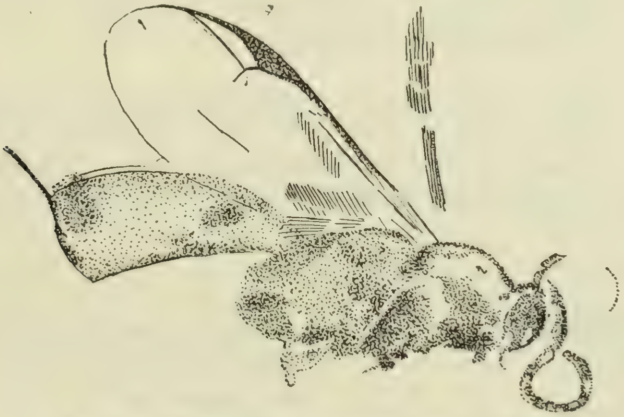

FIG. 84.— Agathis juvenilis, sp. nov. Type.

One specimen, collected by Mr. S. A. Rohwer at Station 13. Type in the Amer. Mus. Nat. Hist., it is well preserved except for the basal and posterior parts of the wings.

MICROGASTERINAE.

This group has been found fossil so far only at Florissant. A species of Microgaster was described by the present writer (:**06**), and I can now add Microplitis, and another, Oligoneuroides, which appears to be new.

MICROGASTER PRIMORDIALIS Brues.

Bull. Amer. Mus. Nat. Hist., 1906, 22, p. 496.

This species was described from a single specimen from Florissant collected by Professor Cockerell, but there are in the collection of the Museum of Comparative Zoölogy Nos. 2354–2359, Florissant, Col., no less than five specimens which can be positively referred here (S. H. Scudder Coll. Nos. 3885, 5107, 5249, 6232, and 11,322–13,806. In addition there is another from Professor Cockerell and also five, Nos. 2360–2364 M. C. Z., Florissant, Col. (S. H. Scudder Coll. Nos. 2967, 3026, 5341, 5758, 10,947) which are doubtfully this species.

From the present series, the following characters can be added to those given in the original description:

Antennae 18-jointed, tapering, the joints about one and one-half times as long as thick apically, twice so toward the base. Abdomen sometimes quite dark in color, especially toward the base above; submedian cell longer than the median by one-third the length of the basal nervure. Legs brownish or reddish.

MICROPLITIS VESPERUS, sp. nov. (Fig. 85.)

Sex? Length 3.25 mm. Black, the abdomen more or less piceous; legs dark, wings hyaline. Antennae rather short and tapering evenly from the base; apparently with about 18 joints, the basal flagellar joints two or more times as long as thick, the apical ones about quadrate. Head and thorax smooth and shining, the metathorax with indications of areolation. Abdomen short, scarcely longer than the thorax, shining. Legs not well preserved, but apparently rather stout. Wings broad, hyaline; the stigma broad, triangular, light colored as are also the veins; submedian cell much longer than the median, first discoidal cell above indistinctly petiolate; second cubital cell large, triangular, the cubitus prolonged a short distance beyond its apex; radius beyond the first short section wanting.

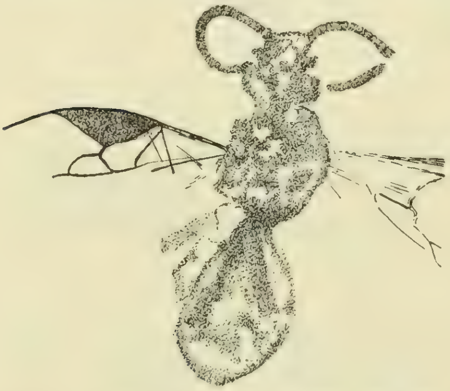

FIG. 85.—Microplitis vesperus, sp. nov. Type.

Described from one specimen sent by Professor Cockerell, A104. Type in the Amer. Mus. Nat. Hist.

This is a very extraordinary species on account of the very large triangular second cubital cell, but as it resembles otherwise the present genus closely, I have not thought it necessary to consider the character of generic value, although if found in living forms it would undoubtedly be so regarded.

OLIGONEUROIDES, gen. nov.

Antennae 25 or 26-jointed, probably 26. Wing venation much as in Oligoneurus Szepligeti, except that the first and second transverse cubital veins are present and the first discoidal cell is separated from the costa by a petiole over one-third the length of the basal vein.

Type.— *O. destructus*, sp. nov.

This peculiar form is undoubtedly a member of the Microgasterinae and on account of its multiarticulate antennae perhaps related to the Brazilian genus Oligoneurus Szepligeti. In wing venation, however, it is quite different and is I think worthy of generic rank.

OLIGONEUROIDES DESTRUCTUS, sp. nov. (Fig. 86.)

Female. Length 4 mm. Black, with reddish abdomen. Antennae and legs black or very dark. Basal joints of flagellum of antennae rather long, two to three times as long as thick; apically becoming more nearly quadrate and much smaller. Surface of head and thorax smooth and shining. Mesonotum apparently with parapsidal furrows which meet far before the scutellum. Abdomen short, globose, ovipositor at least two-thirds its length and possibly longer. Wings large and broad; radial vein abbreviated, but distinct for a considerable distance beyond the transverse cubitus. Submedian cell quite distinctly longer than the median; discoidal vein broken at its posterior tip, leaving the third discoidal cell open at the tip.

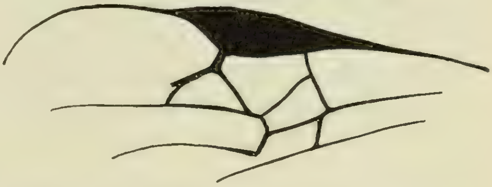

FIG. 86.— Oligoneuroides destructus, sp. nov. Type.

Type.— No. 2365, M. C. Z., Florissant, Col. (No. 857, S. H. Scudder Coll.).

Described from one specimen seen in dorsal view. It resembles *Microgaster primordialis* Brues in color and size, although otherwise far removed. Later a second specimen with reverse was sent in a lot received from Professor Cockerell, it agrees perfectly in structure and color, but the wing venation is not so well preserved.

OPIINAE.

There is a single poorly preserved specimen, No. 2294 M. C. Z. (No. 12,796, S. H. Scudder Coll.) which appears to belong to this group, but I cannot be positive. The marginal cell is very long and broad, reaching to the extreme tip of the wing, and the insect has the habitus of a Cardiochiles.

BRACONINAE.

But one genus, Bracon in the widest sense, has been found fossil. It is recorded from many localities, both in Amber and in rock formations. A list of these will be found in the catalogue accompanying the present paper. From Florissant, I have three species, one of them represented by a considerable number of specimens.

BRACON Fabricius.

Key to the Florissant species of Bracon.

1. Wings hyaline . . . . 2.
   Wings infuscated, length about 4 mm., second cubital cell twice as long as high at apex . . . . . *B. cockerelli*, sp. nov.
2. Length 8.5 mm., second cubital cell long, nearly twice as long as high at apex . . . . *B. abstractus*, sp. nov.
   Length 12 mm.; second cubital cell but little longer than high; trapezoidal . . . . *B. resurrectus*, sp. nov.

BRACON COCKERELLI, sp. nov.

Female. Length 4 mm. Black or very dark, with the abdomen reddish, sometimes with indistinct darker, transverse bands. Wings infuscated, brown. Antennae black, 32-jointed, tapered beyond the middle to a slender tip; most of the flagellar joints about quadrate, the basal three or four joints of the flagellum from one-fourth to one-half longer than thick. Head and thorax shining, highly polished, impunctate. Abdomen subglobose or ovate both in lateral and dorsal view, about as long as the head and thorax together, acutely rounded at the tip. Ovipositor exserted, as long as the thorax and abdomen together. Legs moderately stout, yellowish or pale reddish brown, the tips of the tibiae and the tarsi (posterior legs?) darker, piceous. Wings very strongly infuscated and violaceous in some specimens. Stigma rather large and broadly ovate, the radius originating from just before its middle, its first section two-thirds as long as the second, the two meeting at a very distinct angle; second cubital cell twice as long on the radius as it is high at the apex; recurrent nervure inserted just before the apex of the first cubital cell; median and submedian cells of equal length in both fore and hind wings.

Seven specimens, type Coll. Amer. Mus. Nat. Hist. A72, others: A31, A35, A128–129, A41; also Nos. 2367–2368, M. C. Z., Florissant, Col. (Nos. 6147 and 8602, S. H. Scudder Coll.). All are well preserved, and there are several others not so perfect which are probably this species, Nos. 2369–2372 M. C. Z., Florissant, Col. (Nos. 1707, 3640, 5032, 6338, S. H. Scudder Coll.). Professor Cockerell's specimens are from Stations 14 and 17.

This is a small species, very similar to the recent *Bracon dorsator* Say and its allies in general habitus.

BRACON ABSTRACTUS, sp. nov.

Female. Length 8.5 mm. Dark colored, the abdomen lighter, reddish except at the base; legs dark; wings hyaline. Antennae long and slender, with many joints (about 40), very gradually attenuated toward the tips; apical joints small, quadrate; those near the middle about twice as long as thick; basal ones still more elongate, three or more times as long as thick; abdomen as long as the head and thorax together, oval, roughly tuberculate on the basal two or three segments and less plainly so on the apical ones. Ovipositor exserted, but only a short basal part is preserved. Legs stout. Wings hyaline, the stigma and veins strongly colored; stigma small, narrowly ovate, very indistinctly angled below, the radius originating at or slightly beyond its middle. Radial cell long and narrow, pointed at the tip, its second section a little more than twice as long as the first; second cubital cell long, nearly twice as long as high at the apex.

Type.— No. 2373, M. C. Z., Florissant, Col. (No. 9276, S. H. Scudder Coll.).

This is similar to the preceding species in wing venation, but is much larger and has hyaline wings.

BRACON RESURRECTUS, sp. nov. (Fig. 87.)

Female. Length 12 mm. Ovipositor 12.5 mm. Apparently entirely light yellowish, the femora and tibiae of the posterior legs darker and the antennae brownish; head above and part of the dorsum of the thorax blackened. Wings hyaline. Antennae very long and slender, nearly as long as the body and gradually attenuated toward the apex; very many jointed, the joints toward the tip short, quadrate, but those near the base considerably elongated, apparently from three to five times as long as thick. Thorax and abdomen only faintly preserved, apparently smooth and shining. Wings hyaline, the stigma and veins dark brown; stigma elongate, but distinctly angled below, the radius originating near its middle. Marginal cell narrow, elongate, acute at the tip; first and second sections of the radius both short, the second fully twice as long as the first; second cubital cell short, trapezoidal, but little longer than high; median and submedian cells of front wing of equal length.

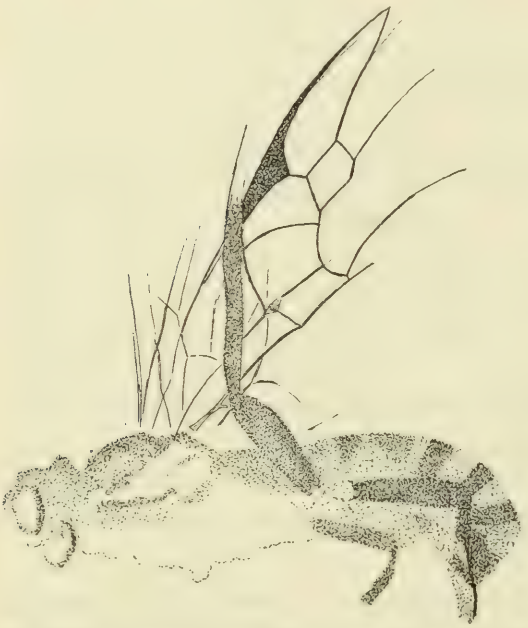

FIG. 87.— Bracon resurrectus, sp. nov. Type.

Described from one specimen and reverse, not particularly well preserved, but very striking on account of its large size. Nos. A137–138, collected at Station 14 by Mrs. W. P. Cockerell.

RHOGADINAE.

The only hitherto described fossil species belonging to this subfamily is *Rhogas tertiarius*, Brues ('06) from Florissant, but later material from this locality contains the following species of Exothecus.

EXOTHECUS ABROGATUS, sp. nov. (Fig. 88.)

Length 5 mm. Ovipositor 6.5 mm. Black, the abdomen toward the tip and the legs brownish; wings hyaline or very slightly yellowish. Antennae piceous, extremely slender and presumably long, although only the basal part about two-thirds the length of the body is preserved; the joints appear to be elongate, about three times as long as thick. Head and thorax seen in lateral aspect, smooth and shining, the eye very large, round; metathorax finely areolate and propleura very finely rugosopunctate. Abdomen elongate, claviform, seen from the side almost petiolate. First segment longer than the slope of the metathorax, finely longitudinally rugose; with a pair of median and lateral carinae which are continued less distinctly on the second segment; apex of abdomen rounded. Legs rather long and slender, brownish. Wings long and quite narrow; stigma and veins light fuscous. Stigma elongate, lanceolate, the radius arising at its middle; radial cell long, nearly attaining the wing tip; submedian cell considerably longer than the median; discoidal vein broken below the middle; recurrent nervure interstitial with the first transverse cubitus; first cubital cell rhomboidal, second elongate, its apex only one-half as long as its upper side and one-third as long as the lower side.

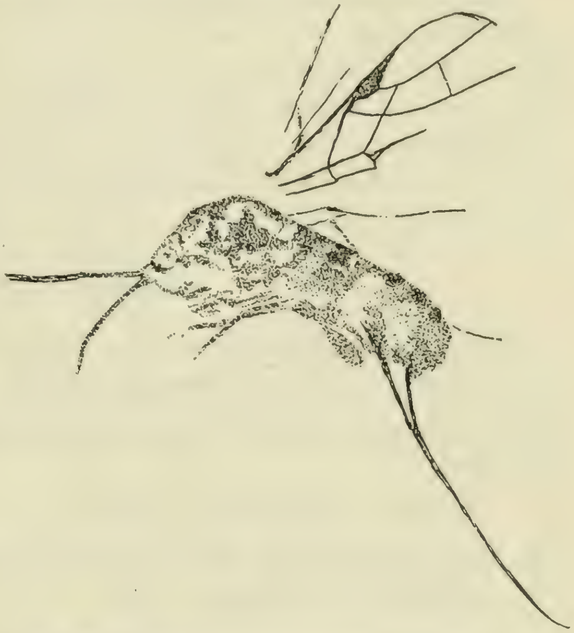

FIG. 88.— Exothecus abrogatus, sp. nov. Type.

Type.— No. A40, in the collection of the Amer. Mus. Nat. Hist.

This species resembles a genuine braconine except for the long submedian cell of the front wing.

SPATHIINAE.

I think it is very probable that *Ichneumon petrinus* Scudder belongs to this group. The very excellent figure given in his Tertiary Insects (plate 5, fig. 14) shows the characteristic form of the body and peculiar antennae of Hormiopterus and its allies, and I take it that the apparent absence of the first section of the cubitus is an accident of preservation.

STEPHANIDAE.

PROTOSTEPHANUS Cockerell.

There is one specimen, No. 5350, S. H. Scudder Coll., which may belong to this genus or perhaps to Megischus. It is not well enough preserved, however, to place definitely in either although I am assured from its general habitus that it belongs to the Stephanidae.

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I have omitted a few references which are of such general nature or so doubtful that they can be of little value to students. I have not attempted to change the places assigned to species by their describers or by previous writers except in a few cases where I am very positive that these are incorrect. On account of these omissions, a few species listed by Scudder and Handlirsch are not found in the present list, but it includes all that are of service to students of palaeontology.

BETHYLIDAE.

Bethylidae Handlirsch, Foss. ins., 1907, lief. 6, p. 858.
Lower Oligocene; Baltic Amber.

Bethylid (problematic) Brues, Bull. Amer. mus. nat. hist., 1906, 22, p. 497.
Miocene; Florissant, Col.

Epyris deletus Brues, Bull. M. C. Z., 1910, 54, p. 8.
Miocene; Florissant, Col.

CERAPHRONIDAE.

Ceraphron sp. Burmeister, Oken's Isis, 1831, p. 1100.
Lower Oligocene; Baltic Amber.

PROCTOTRYPIDAE.

Proctotrypes exhumatus Brues, Bull. M. C. Z., 1910, 54, p. 9.
Miocene; Florissant, Col.

BELYTIDAE.

Belyta mortuella Brues, Bull. M. C. Z., 1910, 54, p. 10.
Miocene; Florissant, Col.

Pantoclis deperdita Brues, Bull. Amer. mus. nat. hist., 1906, 22, p. 497.
Miocene; Florissant, Col.

DIAPRIIDAE.

Paramesius defectus Brues, Bull. M. C. Z., 1910, 54, p. 11.
Miocene; Florissant, Col.

Galesimorpha wheeleri Brues, Bull. M. C. Z., 1910, 54, p. 12.
Miocene; Florissant, Col.

FIGITIDAE.

Figites solus Brues, Bull. M. C. Z., 1910, 54, p. 13.
Miocene; Florissant, Col.

CYNIPIDAE.

Cynips sp. Schlotheim, Petrefactenk., 1820, p. 43.
Lower Oligocene; Baltic Amber.

Cynips succinea Presl., Delic. pragens., 1822, l, p. 195.
Lower Oligocene; Baltic Amber.

Andricus myricae Brues, Bull. M. C. Z., 1910, 54, p. 14.
Miocene; Florissant, Col.

Diastrophus sp. Gravenhorst, Uebers, schles. gesellsch. vaterl. cult., 1834, 1835, p. 92.
Lower Oligocene; Baltic Amber.

Protoibalia connexiva Brues, Bull. M. C. Z., 1910, 54, p. 15.
Miocene; Florissant, Col.

AGAONIDAE.

Tetrapus mayri Brues, Bull. M. C. Z., 1910, 54, p. 16.
Miocene; Florissant, Col.

TORYMIDAE.

Torymus pertinax Förster, Abh. geol. spezialk. Els., 1891, 3, p. 452.
Middle Oligocene; Brunnstaat, Alsatia.

Torymus sackeni Brues, Bull. M. C. Z., 1910, 54, p. 17.
Miocene; Florissant, Col.

Palaeotorymus aciculatus Brues, Bull. M. C. Z., 1910, 54, p. 21.
Miocene; Florissant, Col.

Palaeotorymus laevis Brues, Bull. M. C. Z., 1910, 54, p. 20.
Miocene; Florissant, Col.

Palaeotorymus striatus Brues, Bull. M. C. Z., 1910, 54, p. 20.
Miocene; Florissant, Col.

Palaeotorymus typicus Brues, Bull. M. C. Z., 1910, 54, p. 19.
Miocene; Florissant, Col.

Ormyrodes petrefactus Brues, Bull. M. C. Z., 1910, 54, p. 21.
Miocene; Florissant, Col.

CHALCIDIDAE.

Chalcites debilis Heer, Viert. naturf. gesellsch. Zürich, 1856, 1, p. 29–30.
Lower Oligocene; Aix, France.

Chalcis perdita Brues, Bull. M. C. Z., 1910, 54, p. 24.
Miocene; Florissant, Col.

Chalcis praevalens Cockerell, Bull. Amer. mus. nat. hist., 1907, 23, p. 612.
Miocene; Florissant, Col.

Chalcis tortilis Brues, Bull. M. C. Z., 1910, 54, p. 23.
Miocene; Florissant, Col.

Spilochalcis scudderi Brues, Bull. M. C. Z., 1910, 54, p. 24.
Miocene; Florissant, Col.

EURYTOMIDAE.

Eurytoma sepulta Brues, Bull. M. C. Z., 1910, 54, p. 25.
Miocene; Florissant, Col.

Eurytoma sequax Brues, Bull. M. C. Z., 1910, 54, p. 26.
Miocene; Florissant, Col.

Decatoma antiqua Scudder, Bull. U. S. geol. surv. terr., 1878, 4, p. 749. Tertiary insects N. Amer., 1890, p. 604–605.
Oligocene; Green River, Wyoming.

PERILAMPIDAE.

Perilampus sp. Brischke, Schrift naturf. gesellsch. Danzig, 1886, 3, p. 279.
Lower Oligocene; Baltic Amber.

CLEONYMIDAE.

Cleonymus submersus Brues, Bull. M. C. Z., 1910, 54, p. 27.
Miocene; Florissant, Col.

PTEROMALIDAE.

Pteromalinites oeningensis Heer, Urwelt der Schweitz, 1865, p. 388.
Upper Miocene; Oeningen, Baden.

Pteromalus sp. Helm, Schrift naturf. gesellsch. Danzig, 1899, 10, p. 38. Lower Oligocene; Baltic Amber.

Pteromalus exanimis Brues, Bull. M. C. Z., 1910, 54, p. 27.
Miocene; Florissant, Col.

MYMARIDAE.

Anaphes schellwienieus Meunier, Ann. soc. sci. Bruxelles, 1901, 25, p. 284.
Lower Oligocene; Baltic Amber.

Anaphes splendens Meunier, Ann. soc. sci. Bruxelles, 1901, 25, p. 284.
Lower Oligocene; Baltic Amber.

Eustochus duisburgi Stein, Mittheil. Münch. entom. ver., 1877, 1, p. 30. (Mymar) Meunier, Ann. soc. sci. Bruxelles, 1901, 25, p. 290.
Lower Oligocene; Baltic Amber.

Gonatocerus henneberti Meunier, Miscell. ent., 1905, 13, p. 2.
Lower Oligocene; Baltic Amber.

Limacis baltica Meunier, Ann. soc. sci. Bruxelles, 1901, 25, p. 286.
Lower Oligocene; Baltic Amber.

Limacis armata Meunier, Miscell. ent. 1905, 13, p. 3.
Lower Oligocene; Baltic Amber.

Litus elegans Meunier, Ann. soc. sci. Bruxelles, 1901, 25, p. 285.
Lower Oligocene; Baltic Amber.

Malfattia molitorae Meunier, Ann. soc. sci. Bruxelles, 1901, 25, p. 287.
Lower Oligocene; Baltic Amber.

Mymar sp. Meunier, Ann. soc. sci. Bruxelles, 1901, 25, p. 288.
Lower Oligocene; Baltic Amber.

Palaeomymar succini Meunier, Ann. soc. sci. Bruxelles, 1901, 25, p. 289.
Lower Oligocene; Baltic Amber.

EVANIIDAE.

Evania sp. Burmeister, Oken's Isis, 1831, p. 1100.
Lower Oligocene; Baltic Amber.

Brachygaster sp. Brischke, Schrift. naturf. gesellsch. Danzig, 1886, 6, p. 278.
Lower Oligocene; Baltic Amber.

Aulacus bradleyi Brues, Bull. M. C. Z., 1910, 54, p. 28.
Miocene; Florissant, Col.

Pristaulacus rohweri Brues, Bull. M. C. Z., 1910, 54, p. 29.
Miocene; Florissant, Col.

ICHNEUMONIDAE.

Trogus vetus Brues, Bull. M. C. Z., 1910, 54, p. 31.
Miocene; Florissant, Col.

Ichneumon sp. Brischke, Schrift. naturf. gesellsch. Danzig, 1886, 6, p. 278.
Lower Oligocene; Baltic Amber.

Ichneumon sp. Curtis, Edinb. new philos. journ., 1829, 7, p. 295.
Lower Oligocene; Aix, France.

Ichneumon sp. Defrance, Dict. sc. nat., 1822, 23, p. 524.
Lower Oligocene; Baltic Amber.

Ichneumon sp. Gravenhorst, Uebers. schles. gesellsch. vaterl. cult., 1834, 1835, p. 92.
Lower Oligocene; Baltic Amber.

Ichneumon sp. Schlotheim, Petrefactenkunde, 1820, p. 43.
Lower Oligocene; Baltic Amber.

Ichneumon sp. Serres, Geogn. terrains tert., 1829, p. 229.
Lower Oligocene; Aix, France.

Ichneumon alpha Brues, Bull. M. C. Z., 1910, 54, p. 33.
Miocene; Florissant, Col.

Ichneumon aquensis Heer, Rech. climat. pays tert., 1861, p. 153.
Lower Oligocene; Aix, France.

Ichneumon cannoni Cockerell, Bull. M. C. Z., 1910, 54, p. 39.
Miocene; Florissant, Col.

Ichneumon concretus Brues, Bull. M. C. Z., 1910, 54, p. 40.
Miocene; Florissant, Col.

Ichneumon decrepitus Brues, Bull. M. C. Z., 1910, 54, p. 36.
Miocene; Florissant, Col.

Ichneumon dormitans Brues, Bull. M. C. Z., 1910, 54, p. 39.
Miocene; Florissant, Col.

Ichneumon exesus Brues, Bull. M. C. Z., 1910, 54, p. 37.
Miocene; Florissant, Col.

Ichneumon infernalis Heer, Urwelt der Schweitz, 1865, p. 294.
Upper Miocene; Oeningen, Baden.

Ichneumon longaevus Heer, Insektenf. tertiärg. Oeningen, 1849, 2, p. 166.
Lower Miocene; Radoboj, Croatia.

Ichneumon obduratus Brues, Bull. M. C. Z., 1910, 54, p. 35.
Miocene; Florissant, Col.

Ichneumon pollens Brues, Bull. M. C. Z., 1910, 54, p. 34.
Miocene; Florissant, Col.

Ichneumon primigenius Brues, Bull. M. C. Z., 1910, 54, p. 35.
Miocene; Florissant, Col.

Ichneumon provectus Brues, Bull. M. C. Z., 1910, 54, p. 38.
Miocene; Florissant, Col.

Ichneumon somniatus Brues, Bull. M. C. Z., 1910, 54, p. 40.
Miocene; Florissant, Col.

Ichneumon torpefactus Brues, Bull. M. C. Z., 1910, 54, p. 37.
Miocene; Florissant, Col.

Amblyteles sp. Schöberlin, Soc. ent., 1888, 3, p. 61.
Upper Miocene; Oeningen, Baden.

Ichneumonites bellus Heer, Neue denkschr., 1867, 22, (4), p. 35.
Upper Miocene; Oeningen, Baden.

Phygadeuon sp. Brischke, Schrift. naturf. gesellsch. Danzig, 1886, 6, p. 279.
Lower Oligocene; Baltic Amber.

Phygadeuon sp. Brues, Bull. M. C. Z., 1910, 54, p. 41.
Miocene; Florissant, Col.

Hemiteles sp. Brischke, Schrift. naturf. gesellsch. Danzig, 1886, 6, p. 279.
Lower Oligocene; Baltic Amber.

Hemiteles fasciatus Heer, Insektenf. tertiärg. Oeningen, 1849, 2. p. 170.
Lower Miocene; Radoboj, Croatia.

Hemiteles lapidescens Brues, Bull. M. C. Z., 1910, 54, p. 42.
Miocene; Florissant, Col.

Hemiteles obtectus Brues, Bull. M. C. Z., 1910, 54, p. 43.
Miocene; Florissant, Col.

Hemiteles priscus Brues, Bull. M. C. Z., 1910, 54, p. 42.
Miocene; Florissant, Col.

Hemiteles veternus Brues, Bull. M. C. Z., 1910, 54, p. 44.
Miocene; Florissant, Col.

Pezomachus sp. Brischke, Schrift. naturf. gesellsch. Danzig, 1886, 6, p. 279.
Lower Oligocene; Baltic Amber.

Cryptus sp. Brischke, Schrift. naturf. gesellsch. Danzig, 1886, 6, p. 278.
Lower Oligocene; Baltic Amber.

Cryptus sp. Gravenhorst, Uebers. schles. gesellsch. vaterl. cult., 1834, 1835, p. 92.
Lower Oligocene; Baltic Amber.

Cryptus sp. Schöberlin, Soc. ent., 1888, 3, p. 61.
Upper Miocene; Oeningen, Baden.

Cryptus sp. Serres, Géogn. terrains tert., 1829, p. 229.
Lower Oligocene; Aix, France.

Cryptus antiquus Heer, Insektenf. tertiärg. Oeningen, 1849, 2, p. 168.
Upper Miocene; Oeningen, Baden.

Cryptus delineatus Brues, Bull. M. C. Z., 1910, 54, p. 44.
Miocene; Florissant, Col.

Mesostenus modestus Brues, Bull. Amer. mus. nat. hist., 1906, 22, p. 492.
Miocene; Florissant, Col.

Ichneumonites fusiformis Heer, Neue denkschr., 1867, 22, (4), p. 35.
Lower Miocene; Radoboj, Croatia.

Leptobatopsis ashmeadii Brues, Bull. M. C. Z., 1910, 54, p. 45.
Miocene; Florissant, Col.

Acoenites defunctus Brues, Bull. Amer. mus. nat. hist., 1906, 22, p. 493.
Miocene; Florissant, Col.

Acoenites lividus Heer, Insetenf. tertiärg. Oeningen., 1849, 2, p. 169.
Lower Miocene; Radoboj, Croatia.

Lampronota pristina Brues, Bull. M. C. Z., 1910, 54, p. 47.
Miocene; Florissant, Col.

Lampronota stygialis Brues, Bull. M. C. Z., 1910, 54, p. 47.
Miocene; Florissant, Col.

Lampronota tenebrosa Brues, Bull. M. C. Z., 1910, 54, p. 48.
Miocene; Florissant, Col.

Rhyssa antiqua Heer, Neue denkschr., 1867, 22, (4), p. 36.
Lower Miocene; Radoboj, Croatia.

Rhyssa juvenis Scudder, Tertiary insects N. Amer., 1890, p. 609.
Oligocene; Green River, Wyoming.

Rhyssa petiolata Brues, Bull. Amer. mus. nat. hist., 1906, 22, p. 494.
Miocene; Florissant, Col.

Glypta aurora Brues, Bull. M. C. Z., 1910, 54, p. 49.
Miocene; Florissant, Col.

Glypta transversalis Scudder, Tertiary insects N. Amer., 1890, p. 613.
Oligocene; Green River, Wyoming.

Polysphincta inundata Brues, Bull. M. C. Z., 1910, 54, p. 50.
Miocene; Florissant, Col.

Polysphincta mortuaria Brues, Bull. M. C. Z., 1910, 54, p. 50.
Miocene; Florissant, Col.

Polysphincta petrorum Brues, Bull. M. C. Z., 1910, 54, p. 51.
Miocene; Florissant, Col.

Polysphincta saxea Scudder, Rept. geol. surv. Canada, 1875–76, 1877, p. 268.
Oligocene; Quesnel, B. C.

Pimpla sp. Meunier, Ann. soc. sci. Bruxelles, 1896, 20, p. 277.
Upper Oligocene; Rott im Siebenbirge, Rheinlande.

Pimpla sp. Brues, Bull. M. C. Z., 1910, 54, p. 56.
Miocene; Florissant, Col.

Pimpla sp. Pictet, Traité de paléont. 2e. edit., 1854, p. 382.
Lower Oligocene; Aix, France.

Pimpla antiqua Sauss, Rev. mens. mag. zool., 1852, 4, p. 580.
Lower Oligocene; Aix, France.

Pimpla appendigera Brues, Bull. Amer. mus. nat. hist., 1906, 22, p. 494.
Miocene; Florissant, Col.

Pimpla decessa Scudder, Tertiary insects N. Amer., 1890, p. 612.
Oligocene; Quesnel, B. C.

Pimpla morticina Brues, Bull. M. C. Z., 1910, 54, p. 52.
Miocene; Florissant, Col.

Pimpla rediviva Brues, Bull. M. C. Z., 1910, 54, p. 54.
Miocene; Florissant, Col.

Pimpla renevieri Meunier, Mém. acad. Barcel., 1903, 4, p. 34.
Lower Oligocene; Aix, France.

Pimpla revelata Brues, Bull. M. C. Z., 1910, 54, p. 53.
Miocene; Florissant, Col.

Pimpla saussurii Heer, Viert. naturf. gesellsch. Zürich, 1856, 1, p. 29.
Lower Oligocene; Aix, France.

Pimpla senecta Scudder, Tertiary insects N. Amer., 1890, p. 611.
Oligocene; Quesnel, B. C.

Pimpla senilis Brues, Bull. M. C. Z., 1910, 54, p. 53.
Miocene; Florissant, Col.

Pimpla succini Giebel, Insect. d. vorwelt, 1856, p. 155.
Lower Oligocene; Baltic Amber.

Xylonomus sejugatus Brues, Bull. M. C. Z., 1910, 54, p. 55.
Miocene; Florissant, Col.

Eclytus lutatus Scudder, Tertiary insects N. Amer., 1890, p. 614.
Oligocene; Quesnel, B. C.

Mesoleptus sp. ?. Brischke, Schrift. naturf. gesellsch. Danzig, 1886, 6, p. 279.
Lower Oligocene; Baltic Amber.

Mesoleptus apertus Brues, Bull. M. C. Z., 1910, 54, p. 56.
Miocene; Florissant, Col.

Mesoleptus exstirpatus Brues, Bull. M. C. Z., 1910, 54, p. 57.
Miocene; Florissant, Col.

Tryphon sp. Brischke, Schrift. naturf. gesellsch. Danzig, 1886, 6, p. 278.
Lower Oligocene; Baltic Amber.

Tryphon cadaver Brues, Bull. M. C. Z., 1910, 54, p. 59.
Miocene; Florissant, Col.

Tryphon florissantensis Brues, Bull. M. C. Z., 1910, 54, p. 61.
Miocene; Florissant, Col.

Tryphon lapideus Brues, Bull. M. C. Z., 1910, 54, p. 58.
Miocene; Florissant, Col.

Tryphon peregrinus Brues, Bull. M. C. Z., 1910, 54, p. 60.
Miocene; Florissant, Col.

Tryphon senex Brues, Bull. M. C. Z., 1910, 54, p. 60.
Miocene; Florissant, Col.

Bassus sp. Keferstein, Naturg. erdkörp., 1834, 2, p. 332.
Lower Oligocene; Baltic Amber.

Orthocentrus defossus Brues, Bull. M. C. Z., 1910, 54, p. 62.
Miocene; Florissant, Col.

Orthocentrus primus Brues, Bull. Amer. mus. nat. hist., 1906, 22, p. 495.
Miocene; Florissant, Col.

Camerotops solidatus Brues, Bull. M. C. Z., 1910, 54, p. 63.
Miocene; Florissant, Col.

Exochus captus Brues, Bull. M. C. Z., 1910, 54, p. 64.
Miocene; Florissant, Col.

Tylecomnus davisii Brues, Bull. M. C. Z., 1910, 54, p. 64.
Miocene; Florissant, Col.

Tylecomnus pimploides Brues, Bull. M. C. Z., 1910, 54, p. 65.
Miocene; Florissant, Col.

Protohellwigia obsoleta Brues, Bull. M. C. Z., 1910, 54, p. 67.
Miocene; Florissant, Col.

Ophion sp. Serres, Géogn. terrains tert., 1829, p. 229.
Lower Oligocene; Aix, France.

Labrorychus latens Brues, Bull. M. C. Z., 1910, 54, p. 68.
Miocene; Florissant, Col.

Anomalon sp. Serres, Géogn. terrains tert., 1829, p. 229.
Lower Oligocene; Aix, France.

Anomalon sp. Brues, Bull. M. C. Z., 1910, 54, p. 72.
Miocene; Florissant, Col.

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Miocene; Florissant, Col.

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Miocene; Florissant, Col.

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Miocene; Florissant, Col.

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Miocene; Florissant, Col.

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Miocene; Florissant, Col.

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Miocene; Florissant, Col.

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Miocene; Florissant, Col.

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Oligocene; Green River, Wyoming.

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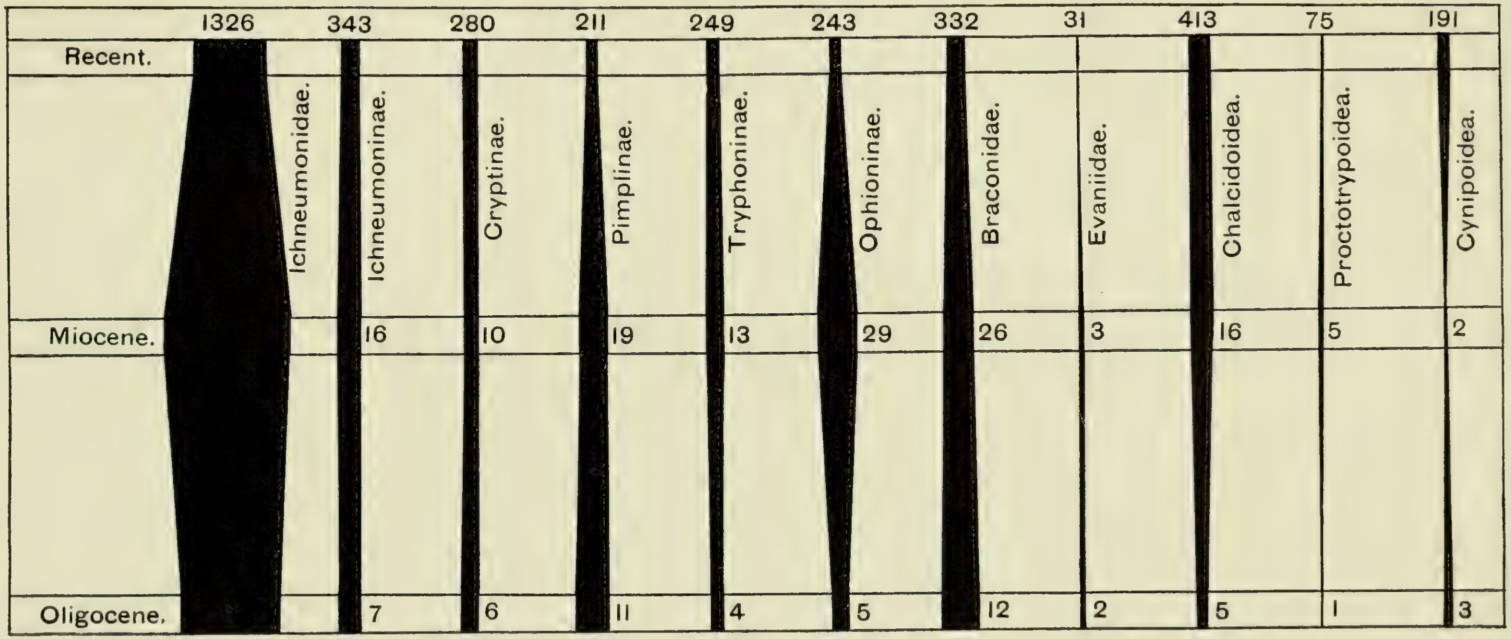


RELATIVE ABUNDANCE OF PARASITIC HYMENOPTERA IN RECENT, MIOCENE, AND OLIGOCENE TIMES.

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
Vol. LIV. No. 2.

SOME WEST AFRICAN AMPHIBIANS.

By Thomas Barbour.

With Two Plates.

CAMBRIDGE, MASS., U. S. A.:
PRINTED FOR THE MUSEUM.
March, 1911.

No. 2.— *Some West African Amphibians.*

By Thomas Barbour.

Thanks to the kindness of Dr. A. G. Ruthven, the Curator of the Museum of the University of Michigan, I have been able to study a series of amphibians collected in the Cameroons by the Rev. George Schwab, who has also recently sent a fine collection direct to this Museum. In connection with this material I have worked over some specimens in the Museum of Comparative Zoölogy from other sources. Since the wonderful amphibian fauna of this region is represented in American museums by so little recently collected material, this list with notes and figures of some of the less known forms will be of interest.

By the generosity of Dr. Ruthven the Museum of Comparative Zoölogy retains the types and a series of duplicates of the species represented in their collection.

Our knowledge of the amphibian fauna of Cameroons has been brought to date most completely, with critical notes and keys for the identification of the genera and species by Fritz Nieden (Mitteil. Zool. Museum, Berlin, 1908, **3**, p. 489–518).

All of the Schwab collection was made at Efulen, Kribi, Cameroons, during 1907–10.

The Barbour collection mentioned in these pages was obtained from various sources, and is now a part of the collection of the Museum of Comparative Zoölogy.

Rana crassipes Buchholz. & Peters.

Four specimens from Efulen, Kribi, Cameroons, Schwab collection.

One of the specimens shows an interesting malformation of the hind foot. Three toes are missing, the second and fourth only being present. The web is almost normal in extent and shape, but thickened and folded back from the inner margin, where it has partially fused on itself. The inner edge formed by the fold is somewhat cornified, and the foot is apparently almost as useful as the normal one.

RANA LONGIROSTRIS Peters.

A series of ten typical examples. Schwab collection, and one with shorter snout from the same locality in the Barbour collection.

RANA MASCARENIENSIS Dumeril & Bibron.

One in the Schwab collection.

RANA ALBOLABRIS Hallowell.

One in the Schwab collection.

RANA ZENKERI Nieden.

Plate 1.

Nineteen half grown and adult specimens from the Schwab collection show some interesting variations from Nieden's description. In the largest examples the snout is considerably longer than the diameter of the orbit, and the first and second fingers may be of the same size, or either one a little longer than the other. In all other respects these agree perfectly with the original description. Three of the examples measure from 240 to 260 mm. from nose to tip of outstretched fourth toe. Nieden's length measure taken in the same way was 160 mm.

SCOTOBLEPS GABONICUS Boulenger.

A single example from Akok, Cameroons, in the Barbour collection, has the dorsal surface of the body quite smooth, in sharp contradistinction to the condition shown in Boulenger's figure of the type (P. Z. S. Lond., 1900, pl. 18, fig. 1).

GAMPSOSTEONYX BATESII Boulenger.

An example in the Barbour collection from Efulen, Kribi, Cameroons as well as one in the Schwab collection from the same locality. I had about decided to consider this second specimen as the type of a new species. Lack of sufficient material, however, makes this doubtful. The specimen in the Schwab collection differs in having very large eyes, larger than shown in Boulenger's figure. (P. Z. S. Lond., 1900, pl. 29, fg. b.) The interorbital space is narrow, less than the width of an eyelid. The back is covered with very fine granules in regular lines instead of being "smooth and shiny." The profile is less slanting than in *G. batesii,* so that the muzzle is thick and heavy.

ASTYLOSTERNUS DIADEMATUS Werner.

Nieden has noted the identity of Astylosternus Werner with Trichobatrachus Boulenger. The seven hairy frogs before me force the conclusion that *T. robustus* Boulenger is a synonym of Werner's *A. diadematus.* The amount of emargination of the tongue, the size and position of the vomerine teeth groups, and the extent of the web between the toes shows such variation as to agree with the descriptions of both these species. Three of the seven specimens were procured some time ago by exchange for the Museum of Comparative Zoölogy; the other four came with the Schwab collection. The University of Michigan received thirteen examples, all from Efulen, Kribi, Cameroons.

DILOBATES PLATYCEPHALUS Boulenger.

A single example in the Schwab collection adds this species to the fauna of Cameroons. Its occurrence is not, of course, unexpected, as most of the species originally described from Gaboon have long ere this appeared in collections from Cameroons.

NYCTIBATES LAEVIS, sp. nov.

Plate 2, Fig. 1.

Type, M. C. Z. 2629, a single example from Efulen, Kribi, Cameroons, taken by the Rev. George Schwab.

Similar in general habit to *N. corrugatus* Boulenger (Ann. Mag. N. H., ser. 7, 1904, **13**, p. 261–2). It differs in smaller tympanum, longer hind limb, large digital dilations, smooth skin on back, and absence of the fine folds on the back converging posteriorly.

Description. Vomerine teeth in two small rounded groups between and very slightly posterior to the choanae. Head large, as long as broad; snout slightly longer than the orbit, with rounded profile; canthus rostralis not especially well developed; loreal region very slightly concave; nostril much nearer tip of snout than eye; eye large and prominent; interorbital space broader than upper eyelid; tympanum not one half the diameter of the eye. Limbs slender; tips of fingers and toes conspicuously dilated into discs; first finger a little shorter than second; toes about one third webbed; subarticular tubercles strong; a conspicuous inner metatarsal tubercle. The tibiotarsal articulation reaches the tip of the snout. Upper parts smooth, lower parts strongly granular. Uniform slate color above, dirty white below. Very faint darker cross bars on the limbs.

NYCTIBATES CORRUGATUS Boulenger.

A fine adult in the Schwab collection. This example differs considerably from the original description. The dorsal asperities are abundantly developed but scattered quite irregularly. They show no tendency to form chevron-like series. There is no triangular dark marking with light colored margin situated between the eyes. The lips are not wholly white but are marked with dusky broad, vertical bars. The inner side of the leg is not black but rather dusky brown with very many white spots. The specimen is unusually well preserved and as it was among the lot collected in 1910, I do not suppose that it has faded very much, if any.

CHIROMANTIS RUFESCENS Günther.

Two examples in the Schwab collection.

PHRYNOBATRACHUS PLICATUS Günther.

Two specimens from Bitye, on the Ja River, Cameroons, Barbour collection, and two from Efulen, Schwab collection.

PETROPEDATES NEWTONII Bocage.

A single adult male, with prominent tympanic stalks. Another male with less prominent stalks, and a female, from the Schwab collection.

PETROPEDATES JOHNSTONI (Boulenger).

The Barbour collection has a specimen from Akok, near Kribi, Cameroons.

LEPTODACTYLODON OVATUS Anderson.

Plate 2, Fig. 2.

The genus and species is figured for the first time from one of the two examples in the Schwab collection.

ARTHROLEPTIS VARIABILIS Matschie.

Two specimens from Kribi, Barbour collection.

ARTHROLEPTIS INGUINALIS Boulenger.

An example from Efulen, Barbour collection, and two in the Schwab collection.

DIMORPHOGNATHUS AFRICANUS (Boulenger).

A specimen each in the Barbour collection, and in the Schwab collection. They are both from Kribi.

RAPPIA OCELLATA (Günther).

One from Bitye, Ja River, Cameroons, Barbour collection.

RAPPIA PICTURATA Peters.

A single example from Anda, Lake Azingo, Gaboon, Barbour collection.

RAPPIA PUSILLA Cope.

One from Efulen, Cameroons, Barbour collection, and one in the Schwab collection.

RAPPIA MARMORATA (Rapp.).

One from Anda, Lake Azingo, Gaboon, Barbour collection.

RAPPIA STEINDACHNERI Bocage.

Two from Bitye, Cameroons, Barbour collection, and four in the Schwab collection also.

MEGALIXALUS FORNASINII Bianco.

Several specimens in the Barbour collection from Lake Asebbe, Gaboon, as well as two in the Schwab collection.

MEGALIXALUS VITTIGER (Peters).

A specimen from Bitye, Ja River, Cameroons, in Barbour collection.

HYLAMBATES AUBRYI Dumeril.

A specimen from Efulen Cameroons, Barbour collection.

HYLAMBATES RUFUS Reichenow.

Numerous specimens from Kribi in both the collections. The "varieties" *boulengeri, notata, modesta,* and *ventrimaculata* in no wise represent distinguishable races in that they all occur in the same area. They are simply individual variations.

HYLAMBATES OCELLATUS Mocquard.

One from Ja River, Cameroons, in the Barbour collection, and five in the Schwab series.

HYLAMBATES CUBITOALBUS Boulenger.

One from five miles inland from Kribi, Cameroons, Barbour collection.

HYLAMBATES CALCARATUS Boulenger.

One from five miles inland from Kribi, Cameroons, Barbour collection.

HYLAMBATES MILLSONII Boulenger.

One from the Ja River, Cameroons, Barbour collection.

HYLAMBATES BREVIROSTRIS Werner.

One from five miles inland from Kribi, Cameroons, Barbour collection, and two from the Schwab collection.

CARDIOGLOSSA GRACILIS Boulenger.

A specimen in the Barbour collection from the Ja River district, Cameroons.

PHRYNOMANTIS BIFASCIATUS (Smith).

Two specimens in the Barbour collection from Angola.

NECTOPHRYNE AFRA Buchholz & Peters.

A single specimen in the Barbour collection from Bitye on the Ja River, Cameroons.

BUFO REGULARIS Renso.

There are two young specimens in the Cameroons collection made by Schwab. There were also examples in the Museum from Cameroons and Gaboon in West Africa, and in the Barbour collection from Angola.

BUFO LATIFRONS Boulenger.

A fine series of all ages in the Schwab collection.

BUFO TUBEROSUS Günther.

Four adult examples in the Schwab collection.

BUFO SUPERCILIARIS Boulenger.

An enormous example in the Barbour collection from the Ja River, Cameroons.

BUFO FUNEREUS Boulenger.

Three examples in the Schwab collection, and another in Barbour collection.

HYMENOCHIRUS BOETTGERI Tornier.

Three specimens from the Ja River in the Barbour collection.

EXPLANATION OF PLATES.

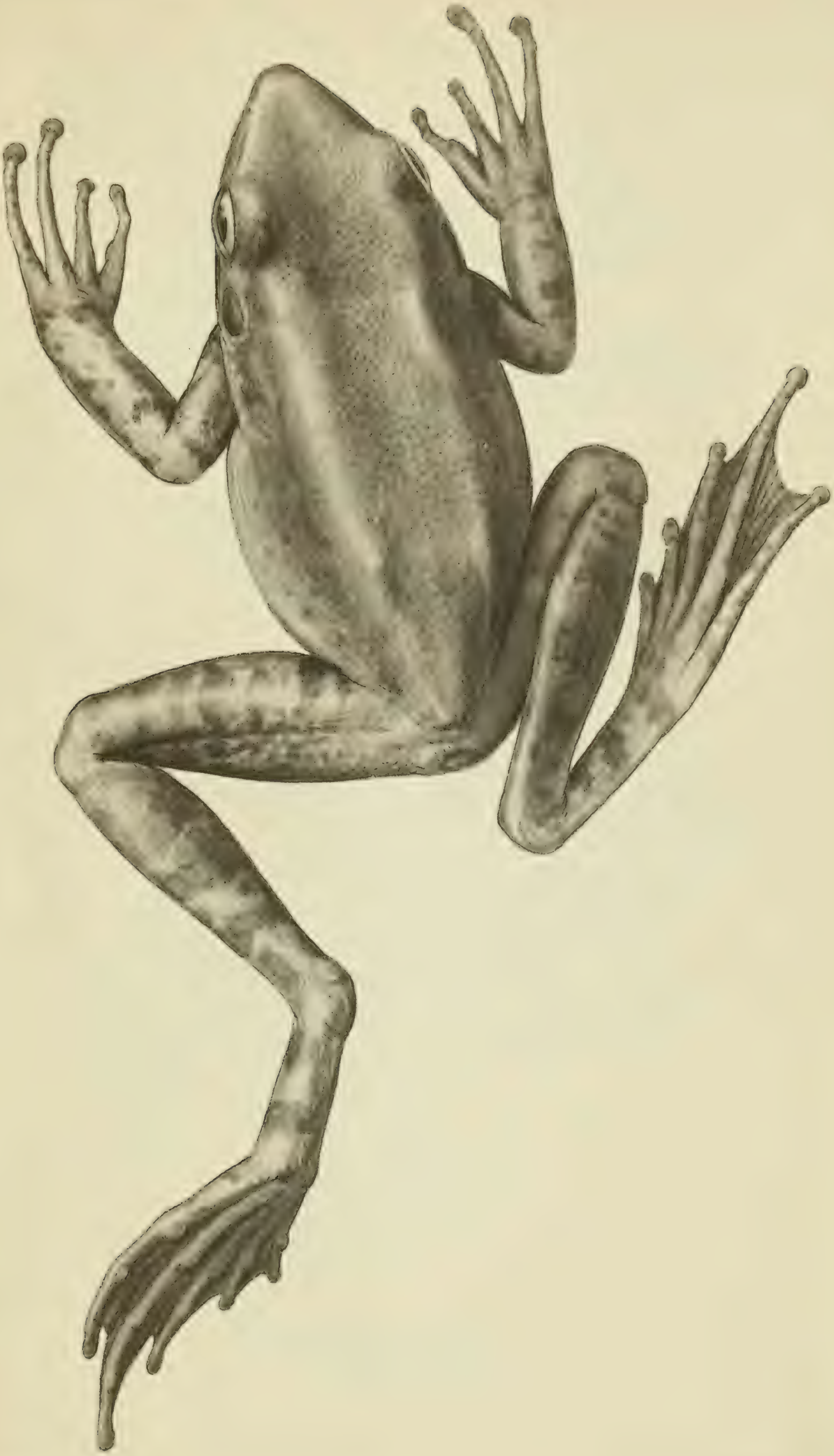
PLATE 1.

Rana zenkeri Nieden. Natural size.

PLATE 2.

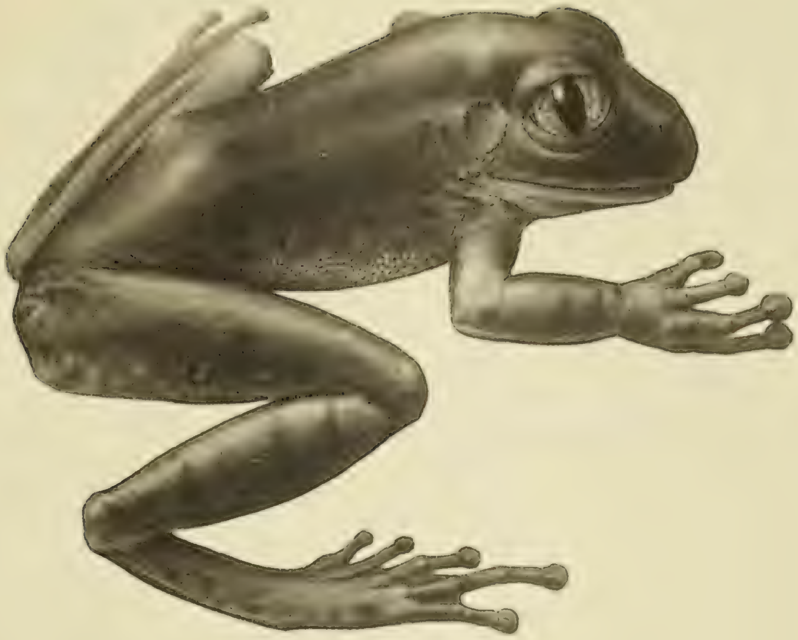
Figure 1. *Nyctibates laevis* Barbour. Lateral view of type. Natural size.
Figure 2. *Leptodactylodon ovatus* Anderson. Natural size.

Plate 1



E. N. FISCHER, DEL.

HELIOTYPE CO., BOSTON



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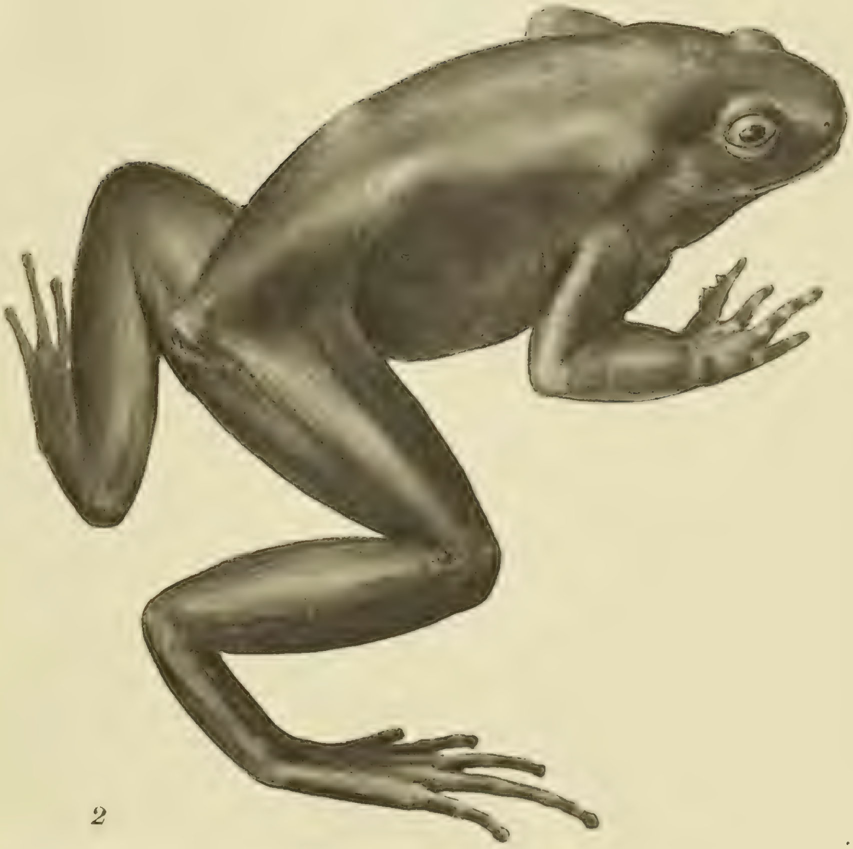

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HELIOTYPE CO., BOSTON

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ALEXANDER AGASSIZ: HIS LIFE AND SCIENTIFIC WORK.

By Sir John Murray.

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No. 3.— *Alexander Agassiz: His Life and Scientific Work.*

By Sir John Murray.[1]

Alexander Agassiz, our distinguished alumnus and my friend, died at sea in mid-ocean on board the S. S. "Adriatic" on Easter Morning, the 27th March, 1910. When this information was received in England by wireless message, it was believed that some mistake had been made, for only a few days previously he had parted with scientific friends in London apparently in most excellent health. The sad news was too speedily confirmed. A few days later I had occasion to speak before an assemblage of scientific men and oceanographers, and I said his death was a great loss to American science, to the science of oceanography, and to all people who take an interest in the progress of natural knowledge. On this occasion I propose to show that this statement was fully justified, and that a truly great man passed from the world when Alexander Agassiz died.

Alexander Agassiz was the only son of the famous naturalist, Louis Agassiz, by his first wife, Cecile Braun, and was born at Neuchatel in Switzerland on the 17th December, 1835. His school days were spent at his birthplace and at the Bürger School at Freiburg, in Baden, Germany, where his maternal uncle was a professor in the University, where his mother and sisters then resided, and where he also came under the influence of a great biologist, Professor Theo. von Siebold. Here were laid the foundations of an education in the French and German languages and in science, which proved a great advantage in his future career. His mother was an artist, and we have hints that her temperament was very different from the placid uniformity which is said to have been characteristic of his father. The father and son are said by Dr. Walcott, who knew them both well, to have apparently belonged to absolutely different types.[2] When I sometimes observed outbursts of indignation, and impatience in Alexander Agassiz, I was always reminded of a passage in the quarrel between Cassius and Brutus in the play of Julius Caesar.

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[1] Memorial Address delivered in Sanders Theatre, Cambridge, Mass., March 22, 1911, at the request of the President and Fellows of Harvard College.

[2] *Boston Evening Transcript*, April 6, 1910.

Cassius exclaims;

"Have you not love enough to bear with me,
When that rash humour which my mother gave me
Makes me forgetful?"

And Brutus replies,

"Yes, Cassius; and from henceforth,
When you are over-earnest with your Brutus,
He'll think your mother chides, and leave you so."

In 1849, at the age of 13 years, the young Agassiz joined his father in America, and his later education took place at Harvard College and the Lawrence Scientific School at Cambridge, Mass., where the elder Agassiz occupied the Chair of Natural History. He used to refer with much pleasure and satisfaction to the manner in which he was befriended, soon after his arrival in the country, by Augustus Lowell, the father of our President Lowell. In 1855 Alexander Agassiz graduated at Harvard. Two years later he took the degree of S. B. in Civil Engineering, and later a second S. B. degree in Natural History. Between 1856 and 1859 he taught in the Agassiz School, and here it was he first met, as a pupil, the young lady who was to become his wife. In 1859 he was appointed an Assistant in the United States Coast Survey, and worked in California and Washington Territory.

In 1860, at the age of twenty-six, he married Anna Russell. It was a love match, and the young couple started out with a very slender income. In the same year Agassiz was appointed Assistant Zoölogist in the Museum of Comparative Zoölogy at Cambridge, founded by his father. His connection with this institution lasted as long as he lived — a full half century. During half of that period he acted as Curator, succeeding his father. On resigning the Curatorship in September, 1898, he served on the Faculty of the Museum as Secretary. In 1902 he was made Director of the University Museum.

In 1863 Agassiz became interested in coal mining in Pennsylvania, but afterwards turned his attention to the copper mines of Lake Superior, acting as Superintendent of the Calumet and Hecla Mines from March, 1867 to October, 1868. It was in consequence of his ability, attention, devotion, and business habits that these mines turned out a great financial success at a later date. Up to the time of his death he was President of this successful company.

In 1869 he had a severe illness at Cambridge from the effects of over-work, anxiety and exposure at Calumet, from which it is believed he never fully recovered. The years immediately preceding this illness had been full of all the financial and other worries connected with mine superintendence and the care of a large and growing business. Still even at this busy period we find the dominant note of Alexander Agassiz's life continuously sounded — the desire to add to the sum of natural knowledge.

As a boy he had accompanied his father on his cruise in the "Bibb" off Nantucket, and in 1851 he aided in the survey of the Florida Reefs. Before he had reached the age of thirty over twenty publications had appeared from his pen in various American scientific journals, the subjects ranging from the flight of Lepidoptera and beaver dams to the position of sandstones on the shores of Lake Superior, and zoölogical classification.

The great majority, however, of these papers deal with marine organisms, such as Medusae, Salpae, Annelids, Actinae, Echinoderms, and various pelagic larvae. These papers, as well as the fact that he published in 1865, conjointly with his step-mother, Mrs. E. C. Agassiz, a popular book on marine life entitled "Seaside Studies in Natural History," show that even in his early career he was fascinated by the ocean, its myriad inhabitants and their conditions of existence. It could not well be otherwise, considering the intellectual atmosphere by which he was surrounded. He took a keen interest in the explorations of his friend, Pourtalès, off the coasts of Florida, and assisted in the description of his collections. In fact Agassiz's early manhood coincided with the great renewal of interest in the physical and biological conditions of the great ocean basins. Maury and Brooke had taught men how to sound correctly the deep sea, and Maury had published his "Physical Geography of the Sea" and a depth chart of the whole North Atlantic. Bailey had examined microscopically the deep-sea deposits under the Gulf Stream; Pourtalès had discussed the formation of green-sand in the same deposits, and the older Agassiz had pointed out the bearing of these new facts on the question of the permanence of continents and ocean basins. The observations of Lovén and Michael Sars had shown that, if there was a zero of life in the great oceans, it must lie at a much greater depth than Forbes had indicated from his observations in the Mediterranean. Wallich, Huxley, and Haeckel had expounded their views on the habitat of the Globigerinae, the shells of which covered the floor of the ocean, and of some organisms brought up from a great depth on sounding lines. The renowned "Bathybius" had been described as a living carpet on the ocean-floor and was accepted by the scientific world. Wyville Thomson, Jeffreys, and Carpenter had conducted deep-sea explorations in the "Lightning," "Porcupine," and "Shearwater," capturing in great depths Crinoids, irregular Sea Urchins, and other marine creatures which were reminiscent of fossil forms.

All these fresh and striking facts, and the speculations connected therewith, must have been present in the mind of the young naturalist when recovering from his severe illness in 1869. One can well imagine how earnestly he desired to take an active part in the new explorations and investigations which were either then being carried out or were projected for the near future. At this time an unexpected occurrence enabled him to realize a long wished-for opportunity of visiting and examining the Echini collections in European Museums and of becoming personally acquainted with the British naturalists then engaged in oceanographical work and deep-sea exploration. One day when recovering from his illness he chanced to meet his friend, Mr. James Lawrence of Boston. Lawrence remarked, "How ill you are looking!" and Agassiz replied that he thought he was dying. "Nonsense," said Lawrence, "what you need is rest and change of scene." "I cannot afford it," was the reply. "Oh yes! you can," said Lawrence, "I'll be your banker." Agassiz never referred to this incident without emotion. He always felt that he owed his life to Mr. Lawrence.

Mr. and Mrs. Agassiz sailed for Europe in the autumn of 1869, with their children and were absent from Boston for fully a year. This was a period of convalescence and of great pleasure and enjoyment; it was also a period of great activity and hard work. His first visit was to Wyville Thomson, who was then Professor at Belfast, in Ireland. Years previously they had been in correspondence about the distribution and development of Echinoderms, and Agassiz was, of course, anxious to see him and to learn all about the "Lightning" and "Porcupine" Expeditions, in which Wyville Thomson had taken part, and concerning which he had just published a Statement of Results. The subsequent correspondence shows that this, as well as another visit towards the end of 1870, gave the greatest satisfaction to both naturalists as well as to their wives. Agassiz then proceeded to visit and examine the Echini collections in nearly every museum in Europe. The great majority of the original type specimens described by the principal writers on the subject during the nineteenth century thus passed through his hands and were critically compared with specimens from the Museum of Comparative Zoölogy in Cambridge and from the recent deep-sea expeditions. A few extracts from his own letters will best indicate his progress, occupations, and impressions during this visit to Europe.

Wyville Thomson had written to Agassiz after his visit to Belfast that he had lost or mislaid some deep-sea specimen, and Agassiz, jocularly, replied from London, assuring him that he had "taken nothing away from Ireland except a bad cold."

From Copenhagen he writes to Wyville Thomson: — "What a pleasant place this is! My wife wishes me to send her kindest regards to Mrs. Thomson and yourself. I am here after a most successful trip through Germany, and am on my way to Stockholm. By the time I get through, we shall have been in every place where there is anything to be seen in the way of type Echinoderms. I am getting on famously as far as the material for the Echini catalogue is concerned. In Berlin I saw many nice things from Japan. I am just finishing the Echinoids here with Lütken, who is a most charming fellow . . . ."

From Switzerland (Leuk, August 8th, 1870) he writes: —"I have done now with my examination of the Echini collections, having now seen them all, and I hope I shall not be prevented from getting out my catalogue very rapidly after my return home."

From Lausanne (August 23rd, 1870) he again writes to Wyville Thomson: — "We have just come back from a charming trip to the mountains, had pleasant weather the whole time, besides doing us all a great deal of good. I am happy to say I am now picking up fast, and if I keep up at the present rate trust to be perfectly well this fall when I go home. We hope to be in London last part of October. We sail 8th November, and I shall manage if possible to take a run to Belfast and see what you have got (that is from the "Porcupine" Expedition.) . . . .I hope you will have the best of luck on your new trip, and find something more astounding than Rhizocrinus, Pourtalèsia, or Calveria. Mrs. Agassiz wishes me to thank you very much for your kind invitation, and to send her kindest remembrances to yourself and Mrs. Thomson."

Here are some extracts from his letters immediately after his arrival at home: —

"We had a capital passage; except two days when it was rough, it was quite pleasant, the whole not lasting more than a little over eight days from Queenstown, which for the season was admirable. I found Father much better than I had hoped to see him again. He manages to come to the Museum for an hour or so a day, sees a few of his friends every day, and keeps going just enough to be employed. He improves daily, and I see no reason why he should not have a long period of usefulness yet, though of course nothing like his old work can now be expected from him again. . . . ."

In March, 1871 he writes (from Cambridge) — "I am just getting out a new edition of the Seaside Studies, which will, however, be a mere reprint." — and in March, 1872, "I hope you will accept the offer to go round the globe, and if you go may you get all the antediluvial things left. I am greatly afraid Father's expedition is not going to result as well as we hoped; the vessel is a great disappointment, five weeks out of ten they have spent repairing. They have left Rio, and the next mail trust to hear from them in the Straits of Magellan."

In April, 1872 he says: — "Don't be alarmed by the number of my epistles. But I wanted to acknowledge at once the safe arrival of the 'Calveria' and of the 'Phormosoma.' I need not tell you how greatly obliged I am to you. . . . ."

The "Revision of the Echini" [1] began to appear the year after his return from Europe. This is the best known of the works of Alexander Agassiz and at once stamped the writer as the leading authority on the subject. Part I. deals with the literature, nomenclature, synonymy, and geographical distribution of the Echini, and extends to 242 pages. Part II. deals with the Echini of the east coast of the United States, including a report on the deep-sea Echini collected in the Straits of Florida by Pourtalès in 1867–1869, and extends to 136 pages. Part III. contains the descriptions of the species of recent Echini, and extends to 251 pages. Part IV. deals with the structure and embryology of the Echini, and extends to 141 pages. The text thus occupies 770 quarto pages, and is illustrated by seven maps showing the geographical distribution and 87 plates giving full figures and details, in addition to numerous wood-cuts in the text. This Report represents an immense amount of work and close study, and it became the standard for all subsequent investigations dealing with this class of animals.

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[1] Revision of the Echini. Illustr. Cat. Mus. Comp. Zoöl. (Cambridge, Mass.,) No. VII., 1872–1874; by Alexander Agassiz. It was divided into four parts for purposes of publication; Parts I. and II. were issued together in 1872, the Introduction being dated August, 1872, Part III. in September, 1873, and Part IV. in January, 1874.

Agassiz throughout his active scientific life was a constant student of Echinoderms. He worked on Starfishes and Crinoids, but the principal object of his interest was the recent Echini. His first publication on this fascinating group of animals was in 1863, and his last in 1909. covering a term of forty-six years, a long period of sustained interest and work. He described a considerable part of the deep-sea species and genera known to science in his Monographs on the Deep-Sea Echini collected by the "Challenger," "Blake," and "Albatross" Expeditions. He described as new, about one-third of the known recent Echini, of which there are some 450 species.

In addition to systematic work, he published on the development and morphology of Echini as well as on their geographical and bathymetrical distribution. His work was almost wholly on recent forms, but in several of his works, especially the Revision, and "Challenger" Report, there is discussion of, and some observations on, fossil Echini.

The three years immediately succeeding his return from Europe in December, 1870 were the most active, fruitful, and enjoyable of his whole life. His financial position had greatly improved and his mind was crowded with new schemes and new ideas with reference to the study of the ocean. He visited the "Challenger" Expedition when the ship reached Halifax in May, 1873. He was enthusiastic about our captures, and he could teach us much we did not know, especially about Echinoderm and Annelid larvae. I remember he showed us how he had proved that *Tornaria* was the larva of *Balanoglossus*. All the younger men of the Expedition were pronounced evolutionists or Darwinists, and the name of Agassiz conjured up opposition to such views, but the impression made by Alexander Agassiz was excellent in every direction, the general judgment being that the younger Agassiz was a very different man from his distinguished father. It was freely prophesied that he would have a very brilliant scientific future. He was buoyant, cheerful, confident, and possessed a fund of dry humour. He was rather above medium height, with brown eyes and dark complexion. He had a fine presence, dignified bearing, and gracious manners. The following note received on board the "Challenger" some months after his visits indicates conscious capacity and the overflowing joy of life:— "We are all flourishing here after a very successful summer at Penikese, about which you must have seen plenty in the papers. The Museum is getting fuller than an egg, and I don't know what we shall do for room. We have just secured the collection of Wachsmuth — the finest collection of *Crinoids* there is from the West, and with what we have, our collection is now superb. I shall attack them soon I hope." (Cambridge, October 24, 1873.)

The scene, the outlook on life, was suddenly changed. His father, Louis Agassiz, died on the 14th December, 1873. His beloved wife, Anna Russell, who had tenderly nursed and watched at the bed-side of her father-in-law during his last illness, caught cold from exposure on the night of his death, and died from pneumonia within ten days thereafter.

This was a terrible blow to Alexander Agassiz. The light and brightness of his life had suddenly been extinguished. A cloud fell upon him which nothing on this earth could completely clear away. His mental attitude towards the future is plainly stated in a letter written from Peru in March, 1875 and received on board the "Challenger" when we were voyaging in the Pacific. It evoked the deep sympathy of the "Challenger" naturalists. He says:— "I hear of your whereabouts through the papers occasionally, though lately I have not seen anything concerning your movements, as I have been wandering about in Chili and Peru, out of the way of all newspapers. I could not stand the associations of my house after the terrible ordeal I had to pass through, and for about five months I have been listlessly running from place to place trying to wake up an interest in outside matters. It is all well enough as long as I am on the move, and there is the excitement of constantly seeing new things and new people, but when I am settled down for any length of time, and attempt to do any continuous work, it is impossible for me to throw off my troubles, and life seems unendurable. Yet I cannot deny that I have had a great deal of pleasure on my trip to South America, and under ordinary circumstances it would have been to me a great store of future enjoyment. As it is I look upon it as so much time passed, and really dread the moment when I shall reach home, or rather my house, for no place can henceforth be a home to me."

Even here, however, what I have called the dominant note of his life — the desire to get new knowledge — rings out strongly, for the rest of this distressful letter is taken up with a detailed description of his exploration of Lake Titicaca. He had taken his Museum Assistant with him to help in making collections for the Museum at Cambridge; he had chartered the only available vessel, had taken water, and air temperatures, had dredged and tow-netted and constructed a bathymetrical chart of this elevated lake, 12,500 feet above sea level — altogether a most interesting description from all points of view.

The Alexander Agassiz before the death of his wife in 1873 was, in my opinion, a very different man from the Alexander Agassiz after that sad event. The first Alexander Agassiz I had seen, but I knew him only very slightly. I have pictured him as he appears to me from his correspondence, from what I have heard from his intimates, and from his own lips. The second Alexander Agassiz I knew well, long and intimately; he was during the last thirty-four years one of my most intimate and valued scientific friends.

During his visit to the "Challenger" at Halifax he promised to come to England on the return of the Expedition to see our deep-sea treasures. When he arrived in Edinburgh I referred to the death of his wife, but he held up his hands and said, "I cannot bear it." His expression was such that the subject was never again mentioned, although he frequently spoke about his boys. He spent fully two months in Edinburgh, but would not at that time attend any social functions. Every day from early morning till as long as day-light lasted he assisted me in opening boxes and bottles and in separating out the various groups of marine organisms, especially selecting the Echini, which he was to take to America, having consented to describe this group of organisms for the Report on the Scientific Results of the Expedition. While this work was going on we had abundant opportunity for discussing the work and results of the expedition and every aspect of the new science of the sea. I was relatively young, and often recounted to him the comic and other incidents of the voyage, and he would smile and seem amused. His attitude was, however, in striking contrast to the boisterous merriment of Haeckel when engaged with me in the same place and in similar occupations. On the conclusion of his visit he wrote to Wyville Thomson on January 23, 1877:—

"I can't tell you what a pleasant time I have had in Edinburgh, thanks to you and Lady Thomson. It is really the first time since the death of father and my wife that I have felt in the least as if there were anything to live for, and I hope you have put me on the track to get into harness again and do my share of the work I have to do, if not with pleasure, at least cheerfully."

During the last thirty-five years of his life Alexander Agassiz's activities and interests were many and varied. The control and direction of the Calumet and Hecla Mines demanded frequent visits to the West, and there we find him conducting valuable experiments in the distribution of underground temperatures in the great depths of the mine. We also find him producing carbonic acid gas to put out a disastrous fire in the mines — said to be the first time this method was thus employed on a large scale.

The first American attempt to found a zoölogical station at Penikese having failed, he established a zoölogical laboratory at Newport to take its place, equipping it with all the necessary appliances and accommodations for twelve students. This institution was carried on for twenty-five years — till it was no longer necessary owing to the establishment of the Woods Hole Marine Biological Station.

The important series of oceanographical or deep-sea investigations with which his name is so closely associated have won for him the gratitude of all subsequent generations of scientific workers. He directed three expeditions in the Atlantic in the U. S. S. "Blake," and three in the Pacific in the U. S. S. "Albatross." These dealt especially with the deep-sea, and yielded an immense number of new organisms and new observations concerning the physical, chemical, biological, and geological conditions of the great ocean basins. Agassiz, being a practical engineer, was able to suggest many improvements in deep-sea instruments and methods; the wire rope for dredging and a modified trawl for deep-sea work were among these improvements. The general account of the Atlantic expeditions is published in two volumes entitled "Three Cruises of the "Blake," and the general accounts of the Pacific expeditions are to be found in the Bulletins and Memoirs of the Museum of Comparative Zoölogy. It would be difficult to overestimate the value of the zoölogical and other collections amassed during these most excellent and extensive explorations.

If we can say that we now know the physical and biological conditions of the great ocean basins in their broad general outlines — and I believe we can do so — the present state of our knowledge is due to the combined work and observations of a great many men belonging to many nationalities, but most probably more to the work and inspiration of Alexander Agassiz than to any other single man. Agassiz's researches in the Atlantic resulted in very definite knowledge concerning the submarine topography of the West Indian region and of the animals inhabiting these seas at all depths — probably we know more of this submarine area than of any other area of equal extent in the world because of his explorations. He arrived at the general result that the deep-sea animals of the Gulf of Panama were more closely allied to those in the deep waters of the Caribbean Sea than the Caribbean forms were to those of the deep Atlantic. Hence he concluded that the Caribbean Sea was at one time a bay of the Pacific Ocean, and that since Cretaceous times it had been cut off from the Pacific by the uprise of the Isthmus of Panama.

When the "Challenger" Expedition carried her explorations down through the central Southern Pacific, she found a rather puzzling state of things. In deep water relatively very few animals were captured on the bottom of the ocean when compared with those taken in the Great Southern Ocean or nearer continental shores; those obtained were, however, of rather pronounced archaic types. The deposits in the same area were of surpassing interest; large quantities of a deep-brown clay were hauled up, in which were imbedded enormous numbers of manganese nodules and concretions, some of them being formed around sharks' teeth, earbones and other bones of whales, and others around volcanic fragments mostly converted into palagonite. Sometimes hundreds of sharks' teeth and dozen of whales' earbones were captured in a single haul, and most of them belonged to extinct species. Small zeolitic crystals and crystal balls were also mixed up in these red-brown clays, evidently formed *in situ*. More extraordinary still were the minute spherules having a hard black coating and an interior of pure iron and nickel, as well as other minute spherules, called chondres, found hitherto only in meteorites. These spherules are believed to have an extra-terrestrial origin, and to have formed at one time the tails of meteorites or falling stars. This was a strange assemblage of things, and some scientific men argued that such a condition of matters must be regarded as local and accidental.

Now Alexander Agassiz explored anew this region of the earth's surface the furthest removed from the shores of continental land, and he found that the same condition of things extended over vast areas of the Pacific Ocean. Here we have almost certainly the region of minimum accumulation on the sea-floor, and recent investigations indicate that there is in these deep deposits more radio-active matter than anywhere else in the solid crust of our planet. A satisfactory and clear understanding of the phenomena has not yet been obtained, but Agassiz's researches take us a long way on the road to a solution of some exceedingly interesting and important oceanic problems.

During the last thirty years of his life, Agassiz became very greatly interested in all coral-reef problems, and organized very many extended expeditions, almost entirely at his own expense, with the view of studying coral reefs, coral islands, and upraised coral formations. It would be wearisome to give even an abstract of all the publications by himself and his assistants dealing more or less directly with these subjects. It can truly be said that he visited, explored, and described with much detail every important coral-reef region of the world, in the Atlantic, Pacific, and Indian Oceans.

Agassiz's special interest in the coral-island problem was apparently first awakened during his visit to Edinburgh in 1876. I had sketched out a series of papers to be presented to the Royal Society of Edinburgh during that session, and he heard the first of these read, viz., "The Distribution of Volcanic Debris over the Floor of the Ocean, its Character, Source, and some of the Products of its Disintegration and Decomposition." He became rather enthusiastic about the results arrived at in the paper. Another of these papers dealt with the distribution of carbonate of lime over the floor of the ocean and with coral-reef formations. One of the most striking results of the "Challenger" Expedition was the discovery of enormous numbers of pelagic calcareous Algae, pelagic Foraminifera, and pelagic Mollusca in the surface and sub-surface waters everywhere within tropical and sub-tropical regions, but the dead calcareous shells of these pelagic organisms were not distributed with similar uniformity over the floor of the ocean. In some places they formed Pteropod and Globigerina oozes, but in the very greatest depths not a trace of these shells could be found in the Red Clays which covered the bed of the ocean. It was observed that the thinner and more delicate shells disappeared first from the marine deposits with increasing depth, and only the thicker and more compact shells or their fragments reached the greater depths. These conclusions were verified again and again during the cruise of the "Challenger," and subsequently by Agassiz in his expeditions. Evidently the calcareous shells were removed by the solvent action of sea-water as they fell towards, or shortly after they reached, the bottom of the ocean. In the shallower depths the majority of the shells reached the bottom before being completely dissolved, and there accumulated. The solvent action was also retarded in these lesser depths through the sea-water in direct contact with the deposit becoming saturated, and therefore unable to take up more lime. The explanations thus given to account for the disappearance of carbonate of lime from deep-sea deposits were then applied to the interpretation of the phenomena of coral atolls and barrier-reefs. It was argued that all the characteristic features of atolls and barrier-reefs could be explained by a reference to the biological, mechanical, and chemical processes everywhere going on in the ocean without calling in the extensive subsidences demanded by the theories of Darwin and Dana.

Agassiz almost at once adopted these views, saying, "I never really accepted the theories of Darwin and Dana; it was all too mighty simple. Besides," he added, "this new view is founded on observation and can be verified, and I'll attempt to do it, and will visit coral-reef regions for the purpose."

Darwin, it will be remembered, stated that his whole theory was thought out on the west coast of South America before he had seen a true coral reef.[1] The method of Agassiz was to see every true coral-reef region of the world before he formed any theory.

Darwin's theory of coral reefs may be briefly stated as follows:— The corals commence by forming fringing reefs along a shore. The shore commences to subside, but the corals grow directly upwards. In course of time a lagoon-channel is formed between the growing reef and the subsiding shore-line. When this process continues for a sufficient length of time the central island completely disappears beneath the waves, and the lagoon of an atoll occupies ultimately the place of the island. The fringing reef thus develops into the barrier reef, and the barrier reef develops into the atoll.

Agassiz writes in 1909 that the result of his studies on coral reefs has been "to dissent *in toto* from the views of Dana and Darwin regarding the mode of formation of barrier reefs and atolls."

In 1902, after his visit to the Maldives, he wrote to me as follows:— "This will be the end of a most successful expedition, perhaps to me the most interesting visit to a coral-reef group I have made. For certainly I have learned more at the Maldives about atolls than in all my past experience in the Pacific and elsewhere. I should never have forgiven myself had I not seen the Maldives with my own eyes and formed my own opinion of what they mean.— Such a lot of twaddle — it's all wrong what Darwin has said, and the charts ought to have shown him that he was talking nonsense. . . . At any rate I am glad that I always stuck to writing what I saw in each group and explained what I saw as best I could, without trying all the time to have an all-embracing theory. Now, however, I am ready to have my say on coral reefs and to write a connected account of coral reefs based upon what I have seen. It will be a pleasure to me to write such a book and illustrate it properly by charts and photographs. But it will be quite a job with my other work on hand. I hope to live to 100! or rather I don't hope, but ought to! to finish all."

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[1] See "Life and Letters of Charles Darwin," vol. 1, p. 70. London, 1887.

Later, in 1907, he writes:— "I have started on my coral-reef book, but it is a job, a good deal more than I expected. If I stay at home I ought to make good progress." Later in the same year he says:— "I fancy I shall have all the time I want to write out my popular account of coral reefs. I have made a fair beginning, and hope to keep the material within reasonable bounds and not allow it to run away with me." Four months before his death he wrote:— "I have worked hard at my coral-reef book," and only a few days before his death he told me in London that he had really sketched out this book three times, but found it very difficult indeed to deal satisfactorily with the mass of information that had been collected. It was his intention, he stated, to write this book during the present year practically for the fourth and last time, leaving out all criticism of the work of others and stating exactly what he had himself observed and his own views.

When in 1903 he addressed the Royal Society of London on coral reefs, he simply described what he had seen in the various coral-reef regions, and did not enter into any controversial matters. The real point of his address came out in the subsequent discussion, viz., that in all his investigations and voyages he had not seen one single atoll or barrier-reef which could be said to be an illustration of the Darwinian theory of coral reefs. It was evident to a large number of naturalists who had themselves observed in the field that the subsidence theory was no more necessary to account for the characteristic features of atolls and barrier reefs than the elevation theory of Darwin — published about the same time — was necessary to account for the Parallel Roads of Glen Roy in Scotland.[1]

It is difficult to account for the heated controversies which have raged around the coral-reef question. Possibly these would never have taken place had the subsidence theory not been associated with the name of Darwin. Very many of the public did not seem to realize that this theory of coral reefs was the work of Darwin when young and inexperienced, and had nothing whatever to do with the theory of natural selection. When the late Duke of Argyll published his famous article entitled "A Conspiracy of Silence," in the Nineteenth Century" (September, 1887), he gave Bathybius and *coral-reef theories* as illustrations, and many people regarded the article as a suggestion that Darwinists and evolutionists were disposed to burke free discussion. This was hotly resented by Huxley and others, while some naturalists seem to have believed they were called upon to defend Darwin's coral-reef theory although they had never seen or examined a coral-reef. Agassiz kept severely aloof from all these controversies, although he writes that he was much amused by the style of various articles and controversies. In one letter to me (March, 1888) he writes: — "I am glad to see by last "Nature" that you are taking a hand in the coral discussion now that it has reached *hard bottom* and no longer deals with imaginary quantities, impossible algebra and metaphysical squibs."

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[1] See "Observations on the Parallel Roads of Glen Roy, and of other parts of Lochaber in Scotland, with an attempt to prove that they are of marine origin," *Phil. Trans.*, 1839, p. 39; *Edin. New Phil. Journ.*, vol. XXVII, p. 395, 1839.

All scientific men must regret that Agassiz was not spared to publish the long-expected summary of his coral-reef work, and to learn that he has not left behind any manuscript suitable for publication giving a connected statement of his views. Such a work from his pen would doubtless have been a splendid edifice erected on the magnificent foundation of observation laid with so much expense, trouble, and care in the elaborate memoirs on the coral-reef regions he had visited in all parts of the world.

Throughout all these coral-reef investigations I have been in substantial agreement with Agassiz's views. In these circumstances I need make no apology for giving a short statement of the conclusions at which, I think, Agassiz had arrived as a result of his coral-reef investigations.

Agassiz claimed, I believe, to have shown that existing atolls and barrier reefs in no way indicate, even approximately, the former position of the shore lines around islands or along coasts now deeply submerged beneath the ocean.

The submerged banks from which atolls and barrier reefs now arise have been formed — that is, they have been built up or levelled down — in a great variety of ways, and at very different times. Each coral-reef region must in this regard be studied by itself, account being taken of the surrounding physical and geological conditions.

The reefs themselves have been very largely — in some instances, predominantly — made up of lime-secreting organisms other than the so-called reef-building corals, such as calcareous Algae, Foraminifera, and corals other than true reef builders, many of which have a wide depth range.

The characteristic features of coral-reefs — the central shallow lagoon and the surrounding rim of living coral with deep water outside — are mainly to be explained by biological, chemical, and mechanical activities continuously in operation at the present time, there being vigorous growth of all lime-secreting organisms wherever the conditions of life are most favourable, and less vigorous growth and even death of these organisms where the conditions are unfavourable. A detailed study of the favourable and unfavourable conditions for different species in an existing atoll, seemed to Agassiz a great desideratum at the present time and I am delighted to learn that this is now being undertaken by American Naturalists under the auspices of the Carnegie Institute.

In small atolls, where the surrounding reef is very extensive relatively to the enclosed lagoon, the lagoon tends to become filled up by the accumulation of coral sand, the deposition carbonate of lime, by the living organisms of the atoll being in excess of that removed in solution and by mechanical means; where the atoll is large, and the encircling reef is — relatively to the size of the lagoon — small, then the lime removed from the lagoon by solution and currents is greater than that deposited by living organisms; hence the lagoon becomes deeper and wider. The lagoon of Diego Garcia appeared to have increased considerably in area in this way between 1837 and 1885.

It is undoubtedly true that many coral-reef regions have been recently elevated. The circular atoll and barrier reef cannot be accepted as evidence of subsidence; the characteristic features of coral reefs would be very similar in a stationary, in a slowly sinking or slowly rising area, although each would show secondary modifications. It matters not whether the change of sea-level be due to crustal movement, to attraction of elevated continental land, or to the accumulation or the melting of polar ice-masses.

When coral plantations rise from a submerged bank, the corals and other lime-secreting organisms situated towards the seaward edge would from the first have the advantage; they would hence reach the surface, before the central portions, where the corals would be in a position more or less unfavourable for vigourous growth. A shallow lagoon would thus be formed, which might subsequently be cleared by solution, and mechanical action of many of its living coral plantations.

The coral atoll, on reaching the surface would, he admitted, in very many cases advance seawards on a talus of its own debris, expanding like a fairy ring, and it seemed to him more than probable that the boring at Funafuti atoll was driven down into such a talus, with an underlying Tertiary base.

The red earth which is found on coral islands and supplies the food for plant life, is chiefly derived from the disintegration and decomposition of floating pumice, which is frequently thrown up by the waves on the reefs.

These results of Agassiz depend on a far greater number of original observations, in widely scattered areas, than have been made by all the other authorities on coral reefs put together.

When we attempt to survey the life-work of Alexander Agassiz, we are astonished at its amount, variety, and quality. His activities in any one direction would have been an excellent record for any one man, but he was many sided. He was largely engaged in commercial undertakings and directed a great business during the whole latter half of his life; he carried on detailed researches and published splendid memoirs on the group of Echinoderms — a subject on which he was regarded as the leading authority. In his deep-sea researches he added greatly to the world's knowledge of the great oceans, and inspired the investigations of a very large number of zoölogical and other specialists. In his study of coral-reefs he travelled more extensively than any man of his time — many thousands of miles — with one special object in view,— to see with his own eyes the varied forms which these gigantic and beautiful natural structures assume under different conditions. We must likewise take into account his work in the laboratory and in the study, where the reports on his many voyages, cruises, travels, and collections had to be prepared for publication. Again one must recall the services he has rendered to his *alma mater* — Harvard University — in his general assistance in administration, his special care of its museums, his donations for extensions in many directions, and lastly his altogether grand series of publications from the Museum of Comparative Zoölogy.[1] His great desire was to add to the sum of natural knowledge by his own work and by the impulse he could give to others imbued with a similar spirit and desire. He worked and struggled continuously and heroically with that end in view, and with those who are now engaged in working up his results and collections in all civilized countries he is still a living force, and will be so for many years to come, for he has arranged for the publication of all the results of these researches. I used to meet him nearly every year either in Europe or in America, when we spent a few days together discussing almost all Oceanic problems. I am conscious of his effect on my life and all my scientific work. As an example of the influence he exerted we have only to look at the introduction to the three splendid volumes recently published on the Medusae of the World by Alfred Goldsborough Mayer, where the initiation and encouragement of a generous master and friend are gracefully acknowledged. Many instances might be cited to show how well and judiciously he applied his wealth to set agoing work which he considered worth doing, not only in his own time but also in the future. The large number of decorations and honours which were conferred on Alexander Agassiz by governments and universities and by learned societies in all parts of the world show abundantly how highly his scientific labours were appreciated by his contemporaries.

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[1] Fifty-two volumes of the "*Bulletin*" and thirty-two volumes of "*Memoirs*".

It has been truly said that man does not live by bread alone. History is crowded with instances illustrating the fact that men have cast off this mortal coil as so much worthless dross when impelled by the demands of some spiritual truth. Other men have endured the greatest hardships and privations in their endeavours to create the beautiful in form, in sound, or in colour. As it has been with the religious and artistic spirit in the past, so is it with the modern scientific spirit. The desire to find out the secrets of nature impels men to trudge over Arctic and Antarctic ice-fields with the satisfaction of all bodily requirements reduced to a minimum and burdened with a load of scientific instruments. Other men expose their bodies to the attacks of pestilential microbes for the advance of knowledge and the betterment of man's estate, while Alexander Agassiz rises with difficulty, when overwhelmed with sickness, and has his mattress laid on the deck of the tossing steamer in order that he may the better record the message which the dredge or trawl has brought to light from the dark abysses of the Atlantic or Pacific Ocean. In such men the body has truly become merely the vehicle of the soul.

It has been said that Alexander Agassiz was a sad and reserved man. It must be admitted that during the latter part of his life he was not so moved by joyous impulses as in his earlier years. Those who knew him well did not find him reserved, and they can testify to the great pleasure he derived from a new discovery or a new view of the interrelations among natural phenomena.

It has also been said that he did not interest himself in the deeper philosophical aspects of the researches in which he was engaged. This I believe to be a mistake. He professed never to engage in discussions except where it was possible to verify one's conclusions by an appeal to observation or experiment. Although he did not publish papers dealing directly with philosophical subjects, still he was keenly interested in all evolutionary problems. He used to say that Darwin had probably explained the survival but not the arrival of species, and he looked forward to a great increase of knowledge from experiments in Mendelism. He believed that the mutation theory had received remarkable confirmation by experiments carried on in recent years. He believed that the doctrines of heredity, which had been so successfully applied to the improvement of domestic plants and animals, would, in the not very distant future, be in like manner applied for the elevation of the human species, the most important of all domestic organisms. He felt convinced that the modern theories as to electrons, the disruption of atoms, and as to energy configurations in the ether being the sole ultimate phenomenal basis of matter would in time profoundly affect the philosophical outlook of many naturalists and their mental attitude generally towards materialism and the riddles of the universe. The study of the world of physical and mental phenomena, he would say, was sufficient for this life. The deeper and more earnestly these were investigated, the brighter and more definite would become the glimpses of that eternal something lying behind all manifestations, which in the meantime he was content to reverence. His religious feelings seemed to be best expressed as a yearning after a higher and better life, which he held would become more attainable and more pronounced as mankind advanced in scientific knowledge. Like all great men he was

"A dreamer of the common dreams,
A fisher in familiar streams:
He chased the transitory gleams
That all pursue,
But on his lips the eternal themes
Again were new."

Great he unquestionably was. Great in his power for work, great in his conception of duty, great in his desire to add to natural knowledge, great in the height of his love, great in the depth of his sorrow, great in his elevated personality, great in his admiration for his University, great in his patriotism, great in his ideas as to the destiny of our race, great in his influence for good, like the genial and vivifying rain from heaven. Like all of us he doubtless had faults, both hereditary and acquired. We know that

"His life was gentle, and the elements
So mix'd in him, that Nature might stand up
And say to all the world, 'This was a man!'"

When his near relatives and dear friends affectionately laid his mortal remains beside those of his beloved wife last March in the Forest Hills Cemetery, well might they ask —

"What hallows ground where heroes sleep?
'Tis not the sculptured piles you heap.
But strew his ashes to the wind,
Whose sword or pen has served mankind.
And is he dead, whose glorious mind
Lifts mine on high?
To live in hearts we leave behind
Is not to die."

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
Vol. LIV. No. 4.

THE GENUS BLAKIASTER PERRIER.

By Walter K. Fisher.

With Two Plates.

CAMBRIDGE, MASS., U. S. A.:
PRINTED FOR THE MUSEUM.
March, 1911.

No. 4.— *The Genus Blakiaster Perrier.*

By Walter K. Fisher.

The object of this paper is to present some figures of *Blakiaster conicus*, with notes on one of Perrier's type specimens (No. 247, M. C. Z.) from off Havana, 175 fathoms. I am indebted to the authorities of the Museum of Comparative Zoölogy for the privilege of examining this specimen.

There have been only two figures of *Blakiaster conicus*, the original of Perrier (Nouv. arch. Mus. d'hist. nat., 1884, ser. 2, **6**, p. 265, plate 9, fig. 2), too small alone to be of service, and a drawing by Verrill (Trans. Conn. acad., 1899, **10**, p. 218, pl. 27, fig. 7) of two actinal pedicellariae. The accompanying photographic figures and drawings are published in the hope that they will serve as an aid to identification, should this genus be found in other parts of the world.

The specimen is small (R=26 mm.) and is possibly immature. The abactinal plates are subcircular in general form, with six or seven short lobes, by which they imbricate; the median radials are more definitely hexagonal with short lobes; the proximal plates of the radial series are surrounded by smaller secondary plates, six about each, but not extending far along the ray. The plates bear a low convex tabulum, not so high as the width of the plate, surmounted by a divergent group of short spinelets, the central the stoutest. These spinelets are microscopically thorny. The plates although paxilliform are not typical paxillae. Those on center of disk are slightly smaller, on account of the smaller secondary plates being more numerous. One series of plates reaches the terminal plate which is conspicuous and well shown in the photographic figure (Plate **1**). Papulae are single, and are absent from center of disk and a median radial streak. Ordinarily there are about six surrounding each plate.

The marginal plates are massive and opposite. The superomarginals are covered with delicate spinelets which become shorter and coarser, consequently more granuliform, on the abactinal surface. There are no specialized spines. The inferomarginals are more tumid and bear a lateral, oblique, transverse series of two or three appressed, delicate, needle-like spines, shown on one ray in the photograph (Plate **1**). They resemble the inferomarginal spines of Persephonaster and Tritonaster, and of some species of Astropecten. The inferomarginals encroach more on to the actinal than do the superomarginals on to the abactinal surface. The proximal marginals have narrow shallow fascioles between them, but beyond the third plate they become rudimentary.

The actinal intermediate plates are in three series parallel to furrow. The first extends nearly to the fifth superomarginal, the second series to the middle of the second, and the third does not reach the second inferomarginal. The second and third series each have an odd interradial while another odd plate, opposite the suture between the first inferomarginals represents the beginning of the fourth series. These plates are dotted Plate **2**, figure 5. The first actinal series, that adjacent to the adambulacral plates, does not possess an odd plate. At first sight these odd interradial actinal plates seem to constitute a trivial character, but they are, on the contrary, of generic importance being absent in the following genera: Persephonaster, Tritonaster, Psilaster, Bathybiaster, Thrissacanthias, Astropecten, Plutonaster, Dytaster, and probably Moiraster. They are present in Leptychaster (*arcticus, pacificus, anomalus, propinquus*), Patagiaster, Dipsacaster, Tethyaster, and Ctenophoraster. The actinal plates are convex and covered with short slender spinelets. As Verrill states (loc. cit.), the interspaces do not form well developed fascioles, which would hardly be expected since the marginal fascioles are so poorly developed. Internally, the plates are subcircular or ovate with an undulating outline, and imbricate strongly.

The adambulacral plates are set somewhat obliquely. They are proximally wider than long, but distally the two dimensions are nearly equal. The first ten plates equal four inferomarginals. The furrow margin is angular, the adoral facet being shorter than the other. The first plate is not conspicuously compressed. The type of armature most nearly resembles that of Leptychaster, and is shown by the figures (Plate **2**, figs. 1 and 2). There are usually four or five furrow and numerous subambulacral spinelets, of which none are conspicuously enlarged.

The combined mouth plates are rather broad and convex, the surface being covered with numerous spinelets which are small on the outer parts, but which increase in length toward the inner angle. Marginal spinelets are about nine, tapering, cylindrical, the innermost abruptly enlarged to form a blunt tooth. These two teeth are however obscured by the tuft of suboral spines which project over them.

Spiniform pedicellariae with four to six papilliform blades occur sparingly on the actinal intermediate and adambulacral plates. The spinelets forming this apparatus surround a slight pit or depression in the plate (Plate 2, fig. 5) and are similar though a trifle blunter and stouter than the others, especially on the adambulacral plates. Verrill figures two, and he found similar but smaller ones with three or four blades on the marginal and abactinal plates. These pedicellariae appear to be very similar to those occurring in some species of Persephonaster, for example *cingulatus* from the Hawaiian Islands.

There are well-developed superambulacral plates (absent from the first ambulacral plate). The tube feet are pointed as in other genera of the Astropectinidae, and the ampullae are strongly double. There are no deposits in the tube feet. I have been unable to find an intestinal coecum. Verrill has found an anal pore in his specimen but I can not be sure that the pore, which is present in the specimen studied is not artificial. It is unusually far from the center of the disk. The madreporite is small, near the margin, and the irregular and relatively few, coarse ridges cross the body from one side to the other in an interradial direction.

Blakiaster shows closer resemblance to Persephonaster than to any other genus of the Astropectinidae. In certain features it also recalls Leptychaster. Its similarity to Persephonaster concerns the following features which are essentially alike in the two genera. The tumid marginal plates with their obsolete fascioles; the type of armature of the inferomarginal plates; the madreporic body; the armature and form of the intermediate plates. The adambulacral and oral plates are very similar, the armature being much alike. In typical species of Persephonaster the adambulacral plates are longer and the margin is less angular and more rounded, with more numerous furrow spinelets. In *P. patagiatus* (Sladen) the adambulacrals are rather more angular than in *P. cingulatus* (Fisher) and in several undescribed Philippine species, and the adoral facet is the shorter, but the furrow spinelets are more numerous and the plates longer in proportion to width than in Blakiaster. The number of spinelets is hardly of generic importance. In Persephonaster as in Blakiaster there is a moderate number of undifferentiated subambulacral spinelets; none are specialized or enlarged as in Thrissacanthias and Sideriaster. The compression of the first adambulacral plate varies in Persephonaster. It is less compressed than in Leptychaster, and in some species more than in Blakiaster; in at least one species it is identical with that of Blakiaster. The mouth plates of the typical species of Persephonaster, and of Tritonaster have a peculiarity in the marginal armature, easily recognized. The marginal and usually also some of the adjacent suboral spines form a prominent angular cluster at the mouth of the furrow and to the side of the enlarged tooth, the apex being nearer the peristome than is the base of the latter. That is, the marginal series bends downward deep in the furrow and then remounts to the base of the tooth. In Blakiaster there is a slight hint of this, but the series is not at all strongly angular and does not form a cluster deep in the furrow. The suboral armature is similar in the two groups.

An important difference between the two genera is the abactinal skeleton. In Persephonaster the plates are independent, low, flat-topped paxillae, hexagonal to lozenge-shaped, and sometimes with slight indication of lobing. In Blakiaster the skeleton consists of strongly lobed, overlapping, low convex plates simulating tabulate paxillae. The actinal intermediate plates in typical Persephonaster extend farther along the ray and often bear an enlarged specialized spine, and the odd interradial actinals of Blakiaster are never present.

The resemblance of Blakiaster to Leptychaster is in the armature of the adambulacral, mouth, and actinal intermediate plates, but the resemblance is no closer than that existing between *Leptychaster pacificus* or *L. anomalus* and Persephonaster. Leptychaster like Blakiaster has a row of odd interradial actinal intermediate plates. The abactinal and marginal plates of Leptychaster are wholly unlike those of Blakiaster. If Blakiaster really lacks an intestinal coecum, which I am inclined to doubt, the genus will be sharply set off from other Astropectinidae.

The genus Bunodaster, very briefly diagnosed by Verrill (Amer. nat., 1909, **43**, p. 554, fig. 4), seems to be identical with Blakiaster. Professor Verrill has kindly furnished me with enlarged photographs of the type, *B. ritteri*. The abactinal plates, described by Verrill as pseudopaxillae, are, superficially at least, like those of Blakiaster. The same is true of the marginal and actinal plates with their armature. The actinal intermediate plates are similar in distribution and the second and third series each has the odd interradial plate precisely as in Blakiaster. I can find no differences in the adambulacral and mouth plates.

PLATE 1.

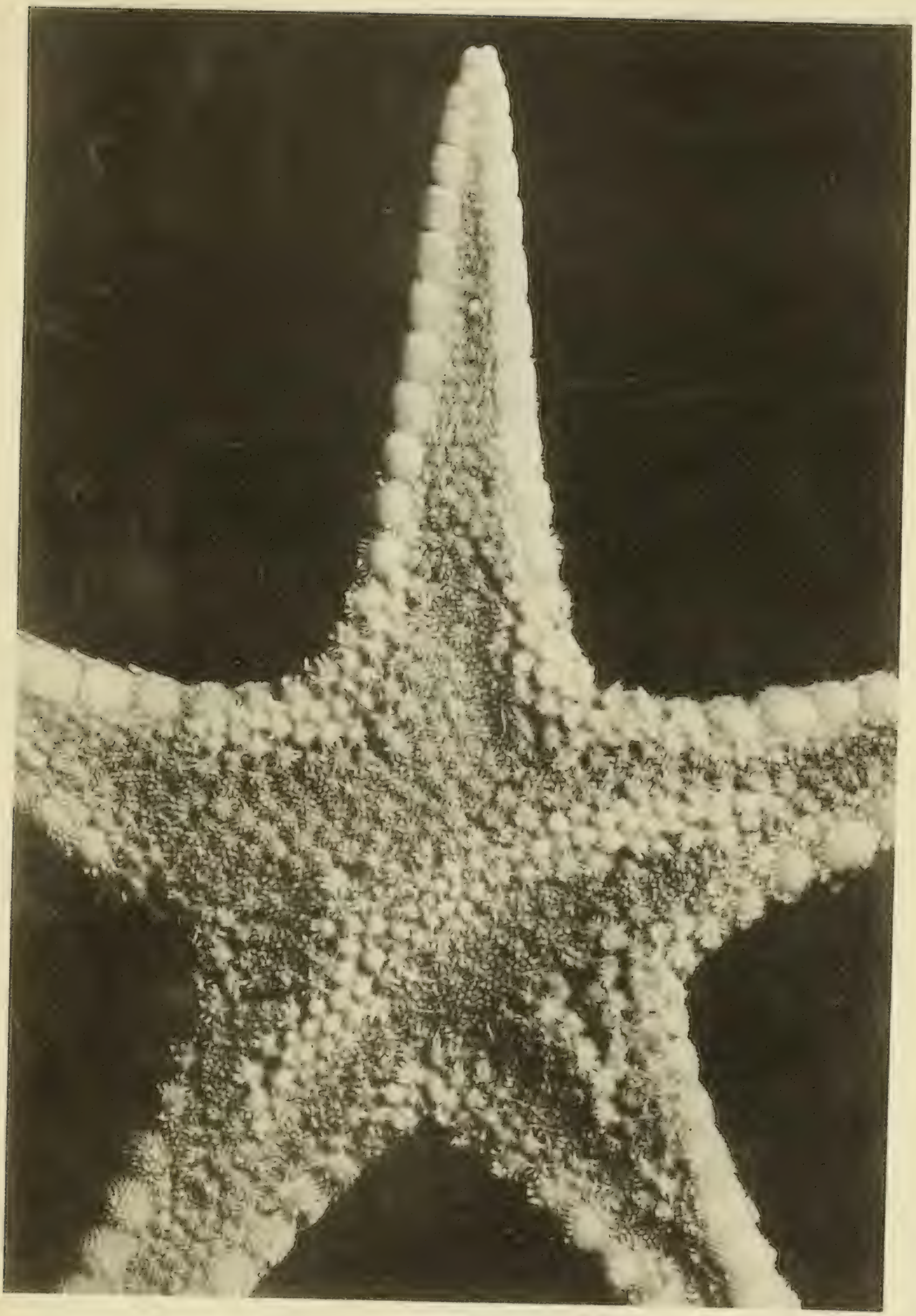
Blakiaster conicus.

Abactinal surface enlarged slightly over 4 times.

PLATE 2.

Blakiaster conicus.

Fig. 1. Portion of actinal surface of disk, enlarged about 5 times.
2. An adambulacral plate from near the middle of major radius; ×15.
3. An abactinal plate from base of ray; ×15.
4. Spinelets from abactinal plates, enlarged.
5. An actinal interradial area, with spines removed. The odd interradial actinals are dotted; *ad*, adambulacral plates; *m*, the first marginal; ×4.
6. Abactinal plates from inside and base of ray; the smaller secondary plates are shaded; *r-r*, radial series; ×10.



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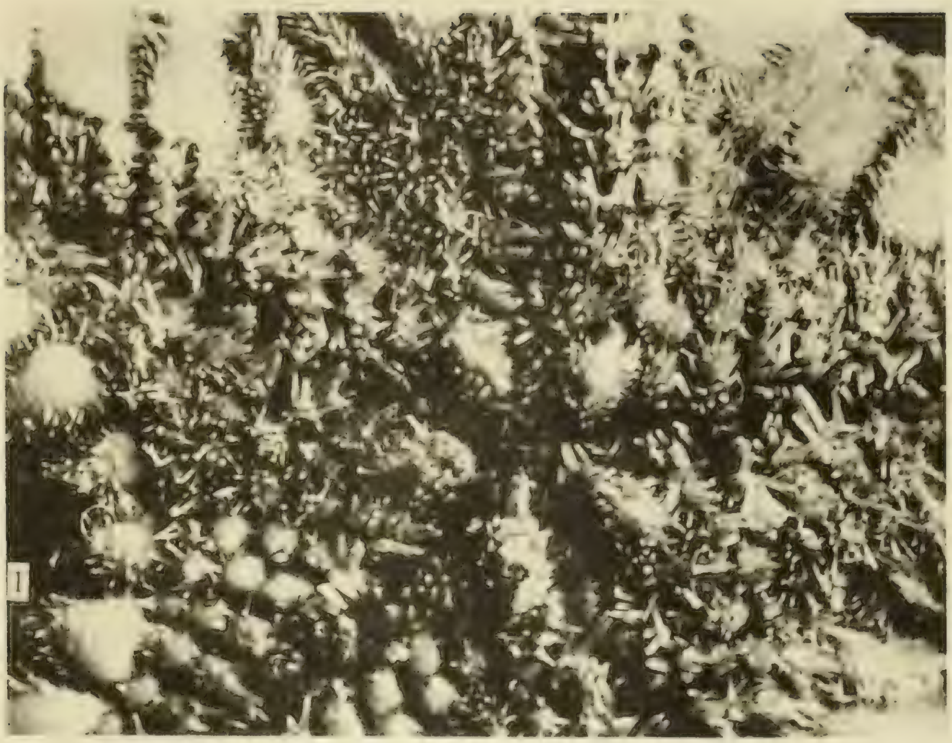
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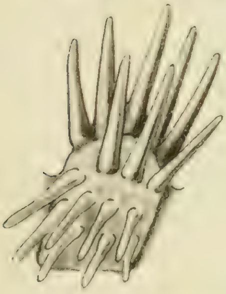
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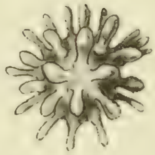
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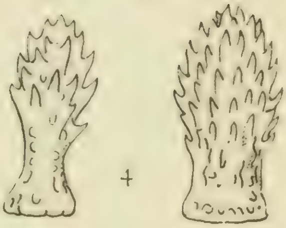
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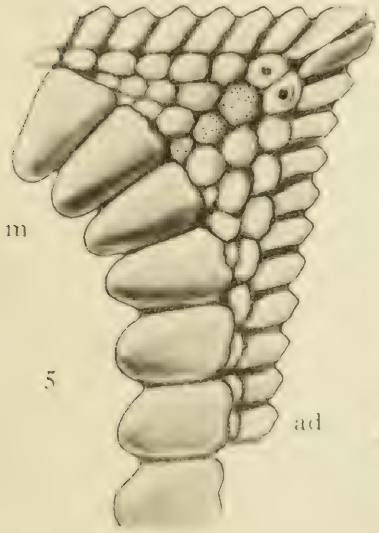
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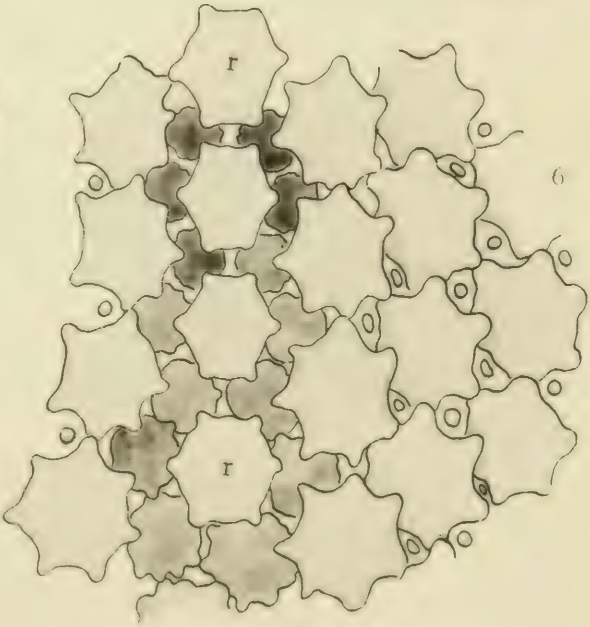
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HELIOTYPE CO. BOSTON

Bulletin of the Museum of Comparative Zoölogy
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Vol. LIV. No. 5.

ANTS COLLECTED IN GRENADA, W. I. BY MR. C. T. BRUES.

By William Morton Wheeler.

CAMBRIDGE, MASS., U. S. A.:
PRINTED FOR THE MUSEUM.
May, 1911.

No. 5.— *Ants Collected in Grenada, W. I. by Mr. C. T. Brues.*[1]

By William Morton Wheeler.

The ants of the island of Grenada were first systematically collected by Mr. H. H. Smith and enumerated in a short paper by Prof. Auguste Forel.[2] Thirty forms, nearly all of wide distribution in the West Indies, are cited.

During the summer of 1910 Mr. C. T. Brues visited Grenada for the Museum of Comparative Zoölogy and made careful search for ants. Although the season was not the most favorable for collecting he succeeded nevertheless in taking specimens of the twenty-four forms enumerated below. Of these the following twelve do not occur in Forel's list:

Euponera (*Pseudoponera*) *stigma* Fabr.
Anochetus (*Stenomyrmex*) *emarginatus* Fabr. (typical).
Leptogenys punctaticeps Emery.
Odontomachus haematodes Linn. (typical).
Cremastogaster brevispinosa Mayr.
Cremastogaster laevis Mayr var. *bruesi,* var. nov.
Pheidole jelskii Mayr var. *antillensis* Forel.
Pheidole triconstricta Forel. var. *bruesi,* var. nov.
Myrmicocrypta brittoni Wheeler.
Iridomyrmex iniquus Mayr.
Camponotus abdominalis nocens, subsp. nov.
Camponotus ustus Forel.

Forel's list, however, comprises the following eighteen forms not taken by Brues:

Leptogenys arcuata Roger.
Anochetus mayri Emery.
Anochetus (*Stenomyrmex*) *emarginatus testaceus* Forel.
Odontomachus haematodes insularis Guérin.
Odontomachus haematodes hirsutiusculus F. Smith.
Eciton klugi Shuckard.
Eciton antillanum Forel.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 38.

[2] Quelques Formicides de l'Antille de Grenada récoltés par M. H. H. Smith. Trans. Ent. soc. London, 1897, pt. 3, p. 297–300.

Pseudomyrma flavidula F. Smith.
Monomorium minutum ebeninum Forel.
Solenopsis castor Forel.
Solenopsis globularia F. Smith.
Wasmannia sigmoidea Forel.
Cryptocerus araneolus F. Smith.
Strumigenys smithi Forel.
Dorymyrmex pyramicus Roger (pale var.).
Prenolepis guatemalensis antillana Forel.
Brachymyrmex heeri Forel var. *obscurior* Forel.
Camponotus abdominalis opaciceps Roger.

It follows, therefore, that only forty-two forms are now known from Grenada, a small number considering its proximity to Trinidad and the mainland, the fact that Forel has recorded seventy-one forms from St. Vincent, an island of about the same size, and the care with which Mr. Brues collected.

FORMICIDAE.

Ponerinae.

1. *Platythyrea punctata* F. Smith.— Several workers from Grand Etang and Richmond Hill.

2. *Euponera* (*Pseudoponera*) *stigma* Fabr.— A single deälated female from Grand Etang.

3. *Leptogenys punctaticeps* Emery.— A few workers and males from a single colony from Grand Etang. The male measures 4.5–5 mm. and in color, sculpture, pilosity and the shape of the petiole is very similar to the worker. The head is as broad as long, nearly circular, with very small, lobe-like, yellow mandibles and the clypeus broad, convex but ecarinate, and with a broadly rounded, entire anterior border. The wings are rather short, distinctly infuscated, with brown veins and black stigma.

4. *Anochetus inermis* Ern. André.— Two workers from Sauteurs.

5. *Anochetus* (*Stenomyrmex*) *emarginatus* Fabr.— Numerous workers and a few males of the typical form from Grand Etang.

6. *Odontomachus haematodes* Linné.— Several workers and a winged female from Richmond Hill are of rather large size and blackish coloration and may be assigned to the typical form of this common tropicopolitan ant.

Myrmicinae.

7. *Monomorium floricola* Jerdon.— A few workers from Sauteurs.

8. *Cremastogaster brevispinosa* Mayr.— Numerous workers from Grand Etang.

9. *Cremastogaster brevispinosa* Mayr var. *minutior* Forel.— A few workers from Richmond Hill.

10. *Cremastogaster laevis* Mayr var. *bruesi*, var. nov.— Several workers from Grand Etang agree closely with Mayr's description and three Brazilian workers received from Forel, except that the hairs on the tibiae are short and appressed, the gaster is black and joints 2–8 of the antennal funiculi are longer in proportion to their width. A deälated female accompanying the workers measures 4 mm., is black, with the legs, antennae, mandibles and articulations of the thorax and gaster brown and the antennal clubs more deeply infuscated. The surface of the body is smooth and shining, with scattered piligerous punctures. The epinotal spines are reduced to short, acute teeth.

11. *Solenopsis geminata* Fabr.— A few workers from Richmond Hill.

12. *Pheidole flavens* Roger subsp. *sculptior* Forel var. *grenadensis* Forel.— A few soldiers and workers from Richmond Hill.

13. *Pheidole guilelmi-muelleri* Forel subsp. *antillana* Forel var. *nigrescens* Forel.— A soldier, a winged female and several workers from Grand Etang.

14. *Pheidole jelskii* Mayr var. *antillensis* Forel.— Several workers from Grand Etang and Sauteurs.

15. *Pheidole triconstricta* Forel var. *bruesi*, var. nov.

Soldier. Length 2.5 mm.

Differing from the typical form in its smaller size, in color and in the length of the antennae. The scapes reach to fully $\frac{2}{3}$ the distance between the eyes and the posterior corners of the head. The body and appendages are yellow, the thorax and tip of gaster sometimes slightly brownish; the borders of the mandibles are black, the anterior border of the clypeus dark brown.

Worker. Length 1.6–2 mm.

Colored like the soldier. The antennal scapes surpass the posterior corners of the head by fully $\frac{1}{3}$ their length.

Described from three soldiers and several workers taken at Grand Etang.

This form resembles the var. *ambulans* Emery of Buenos Aires in the length of the antennal scapes in the soldier and worker but differs in color, Emery's form being dark brown like the type of the species.

16. *Wasmannia auropunctata* Roger.— One deälated female and many workers from Sauteurs and Richmond Hill.

17. *Cyphomyrmex rimosus* Spinola.— Numerous workers and two deälated females from Richmond Hill.

18. *Myrmicocrypta brittoni* Wheeler.— Four males and twelve workers from a single colony found in the sand of the sea-shore at Point Saline. The male, which has not been described, differs from that of other species of the genus (*M. dilacerata* Forel, *subnitida* Forel, *godmani* Forel and *uncinata* Mayr) in lacking the various crests, teeth and spines on the head and thorax. These regions in *brittoni* are all smooth and unarmed. The head is like that of the worker but smaller, with large eyes and ocelli; the thorax has a convex scutellum and the epinotum has small blunt elevations in the place of spines or teeth. The genitalia are large and exserted and quite unlike those of *dilacerata*. The surface of the body and appendages is opaque and very finely granular or punctate, with short, scattered and appressed, yellowish hairs. Color black; mandibles, funiculi, tarsi and genitalia yellowish; scapes and legs brown. Wings grayish hyaline, with very pale, almost colorless veins and stigma. Length 2.3–2.6 mm.

In the absence of the ridges and spines on the head and thorax and in the shape and large size of the genitalia, the male *M. brittoni* differs so much from the males of the other known species, that it may have to be placed in a distinct genus or subgenus. This had better not be done, however, till we have more material of the various species of the genus and especially the females, which seem to be unknown in all the species except *M. uncinata*.

Dolichoderinae.

19. *Iridomyrmex iniquus* Mayr.— Numerous workers, males and females from several colonies nesting in the ground at Grand Etang and Sauteurs.

20. *Dorymyrmex pyramicus* Roger.— Several workers of the typical form from Sauteurs.

Camponotinae.

21. *Prenolepis longicornis* Fabr.— Several workers from Richmond Hill.

22. *Camponotus abdominalis* Fabr. subsp. *nocens,* subsp. nov. *Worker major.* Length 10–11 mm.

Mandibles shining, finely striated and coarsely and sparsely punctate; head opaque, finely and densely punctate, slightly shining on the sides and in front. Elongated foveolae on the cheeks small and not abundant. Thorax, petiole, gaster and legs shining; gaster very finely and transversely shagreened. Antennal scapes subopaque.

Hairs fulvous, long, erect, but much less abundant than in the typical *abdominalis,* confined to the vertex, clypeus, gula, mandibles, thoracic dorsum, border of petiole, surface of gaster and fore coxae. There are a few scattered, suberect hairs on the flexor surfaces of the femora and a few (less than half a dozen) on the extensor surface of each tibia. Pubescence yellow, very sparse, most distinct on the gaster, cheeks and antennal scapes.

Rich yellow; head, antennae and tarsi red, with the vertex and mesial portions of the cheeks brown; mandibular teeth, corners of clypeus, anterior borders of cheeks and apical two-thirds of antennal scapes black; posterior half of first gastric segment and the whole of the remaining segments, except their posterior margins and sometimes portions of the venter, dark brown.

Worker minor. Length 6–7 mm.

Like the worker major, except that the head is more shining, the antennal scapes are not blackened and nearly the whole of the first gastric segment is yellow. The head is subrectangular, broad behind the eyes, with straight posterior border and distinct posterior corners.

Female (deälated). Length 14–15 mm.

Resembling the worker major. Head narrower, with straight, anteriorly converging sides, sharp posterior corners and straight posterior border. Thorax and gaster more glabrous and shining; otherwise the sculpture, color and pilosity are like those of the worker major. The mesonotum has a faint brown anteromedian and two lateral spots. The border of the petiole is rather deeply notched in the middle.

Described from two females and a number of workers taken from rotten logs at Grand Etang and Richmond Hill.

The vivid coloration and feeble pilosity place this form in the group of *abdominalis* subspecies comprising *sharpi* Forel of St. Vincent and *hannani* Forel and *willardi* Forel of Jamaica. It really represents one of the transitions between these insular forms and those of the American continent like *atriceps* F. Smith and *opaciceps* Roger. It differs from *hannani* and *willardi* in color, in lacking the erect hairs on the scapes and in having very few such hairs on the legs; whereas *sharpi*, with which it is very closely related in color, has absolutely no erect hairs on the legs. Perhaps *nocens* should be regarded merely as a variety of *sharpi*, rather than as an independent subspecies.

23. *Camponotus sexguttatus* Fabr. var. *grenadensis* Forel.— Numerous workers, males and winged females taken from hollow stems at Grand Etang and Richmond Hill.

24. *Camponotus ustus* Forel.— A few workers from Grand Etang.

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MAMMALS OF THE WEST INDIES.

By Glover M. Allen.

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No. 6.— *Mammals of the West Indies.*

By Glover M. Allen.

Introduction.

During August and September of 1910 the writer made a small collection of mammals in the island of Grenada. The study of these and of other West Indian specimens in the collection of the Museum, suggested the preparation of a list of mammals known to occur in the West Indies, with a summary of their recorded distribution and its zoögeographical bearing. Most of the conclusions reached are not new, but are of value in connection with similar studies of other groups of animals. The evident gaps in our knowledge of the distribution of many species is made evident by the summary table given. Three new island races are described. No account is taken in this paper of the aquatic mammals nor of domestic animals that have become more or less feral in some of the islands. The bibliography includes most of the important papers dealing with the mammals of the West Indies.

It is a pleasure to extend thanks to His Honor Robert S. Johnstone, now Chief Justice at Grenada, to whom I am indebted for unfailing hospitality and effective assistance while collecting in that island, as well as previously during a visit to the Bahamas.

Zoögeographical Relations.

Much has been written on the derivation of the West Indian land fauna, especially as to that of its molluscs, amphibians, reptiles, and birds. Hitherto but little attempt has been made to examine carefully the distribution of its mammals with a view to discovering evidence in confirmation or disproof of current theories regarding former land bridges, or other means of immigration. No doubt this is mainly due to the fact that there are comparatively few terrestrial species of mammals in the Antillean region; and the distribution of these is, in the main, so limited, or so imperfectly known, as to be of slight aid. It has been customary to ignore, more or less completely, the facts offered by the geographical distribution of bats in island faunas on the ground that they are capable of flying widely oversea, and hence might readily populate unoccupied ground. Among certain genera it is probable that such a method of distribution may, in sporadic instances, obtain. That it is frequent and normal, however, is equally improbable. It is well known that certain species of the temperate zones retire from the higher latitudes of their summer range to winter in more equable climes. In the course of such migrations they are occasionally met with far from land. This seasonal migration for example, is probably accountable for the occurrence of *Lasionycteris noctivagans* among the Bermuda Islands. Large, strong-flying bats, such as the Old World flying-foxes, often make nightly forays of great length from their roosts to some favorite feeding-ground, and they may even conceivably visit islands within sight of their mainland haunts; but that oceanic islands are often populated in this way there is very little evidence. Indeed, the very fact that where bats are found in islands they have usually become more or less differentiated from their nearest neighbors, and this in a uniform and constant manner, is proof that such fortuitous methods of distribution as have been claimed for these animals are largely inoperative.

Dobson (in 1879) seems to have been the first to insist on the erroneousness of this assumption as to the inutility of bats in zoögeographical study. For, he says, "even if it be granted that the Chiroptera possess great powers of dispersal, it is certain that quite nine-tenths of the species avail themselves of them in a very limited degree indeed, and it is significant that the distribution of the species is limited by barriers similar to those which govern it in the case of other species of mammals." He recalls also the possible transportation of bats from place to place by vessels. The West Indies are beyond the winter range of the northern migratory bats; and, except possibly in the case of a few species to be mentioned, it is almost certain that the present chiropteran fauna of each island is quite stationary. The presence of the less strongly-flying species on the several islands may therefore confidently be assumed as evidence either that they reached these islands by following some former land bridge nearly or quite continuous, or that they are autochthonous.

In the following discussion, the evidence of the terrestrial mammals will be first considered. Of these, there are included in the present list some thirty-seven species or subspecies. Eight of these may be at once dismissed as introduced by human agency, *viz.*: *Oryctolagus cuniculus, Mus musculus, Epimys rattus, E. r. alexandrinus, E. norvegicus, Mungos birmanicus, Cercopithecus mona, C. sabaeus.* Possibly the deer occurring on Cuba should be added to this list. A comparison of specimens would show whether it were the same as that of Florida or Yucatan, or if it be really an insular race. Of the remainder we may distinguish, for convenience, two groups: those belonging to genera now known from the Antilles alone, and those belonging to genera that are also represented on the mainland of America. Those of the former group fall at once into two divisions, geographically. The first contains Capromys, Plagiodontia, and Solenodon of the Greater Antilles; the second, Amblyrhiza and Megalomys of the Lesser Antilles. A similar division may be made of the group of mammals that are insular representatives of known continental forms. Thus, in the Greater Antilles are: *Megalonyx rodens,* a fossil ground sloth known from Cuba only, and *Oryzomys antillarum,* of Jamaica, an island representative of *O. couesi,* of the neighboring Honduras peninsula. In the Lesser Antilles, from Tobago northward to and including St. Thomas, are: *Didelphys marsupialis insularis* and *Marmosa chapmani,* opossums both closely related to species of northeastern South America, and a nine-banded armadillo (Dasypus); all of which probably have not by natural means spread farther north than Grenada. The agouti (Dasyprocta), at least until very recently, occurred on practically all of the Lesser Antilles to St. Thomas. The possibility of human interference in carrying this much sought animal from island to island should, however, be kept in mind. The occurrence of Loncheres and Oryzomys in Martinique and St. Vincent respectively is of much interest. The former has been taken only once, but is known to the negroes of Martinique, so that it is possibly native. The latter, as in case of the opossums and the armadillo of the more southern islands, is closely related to a species of the neighboring mainland, and is quite different from that of Central America, whence evidently the Jamaican species was derived. There is every probability that, before the coming of the white man, Oryzomys was of more general distribution in the Antilles; but the introduction of the house and roof rats (Epimys) brought in a competitor against which the rice rat was unable to stand. Even yet, however, a careful search in the more inaccessible parts of some of the larger islands might discover a few survivors.

It is doubtful what significance may be attached to the recent discovery of a small race of raccoon in New Providence (Bahamas) and in Guadeloupe (Windward Islands). A third raccoon is known from Barbados, but its identity is still uncertain. Some have supposed that the silent dogs ("perros mudos") mentioned by the early Spanish explorers as kept by the natives of Haiti were really these raccoons, but such a possibility seems extremely remote. Feilden and others assume with some confidence that the raccoon on Barbados might readily have drifted thither from South America with some of the wreckage of trees and flotsam that is constantly borne to the windward shores of that island by the easterly currents of air and sea. On the other hand, it might readily have been introduced during the past four hundred years by the European invaders. Patrick Browne mentions the raccoon as among the mammals occasionally brought in captivity to Jamaica, but here it is not known to have escaped and established itself.

The presence of the insectivorous genus Solenodon on both Cuba and San Domingo emphasizes the geographic relationship of the two islands. Evidently these primitive animals have been here for a very long period; so that not only have their congeners died out on the neighboring mainland, but they have themselves, through long isolation, become markedly differentiated on the two islands. The fact that their nearest living relative is Centetes of Madagascar need indicate nothing more than that both genera are surviving primitive types of this widespread order that have been preserved in their island habitats, free from the keener competition with the more numerous mainland fauna. The fact that all the known fossil Insectivora of America are found north of Mexico, and that the order is apparently represented in South America by a very recent influx of North American types into the northern part of that continent is quite in line with the fact that Solenodon is found in the Greater Antilles only, and is quite absent from the Lesser Antilles, which, we may suppose, it would have had to reach from the South American mainland.

The terrestrial mammals of the island of Tobago are so evidently derivatives of those in Trinidad that they are not here specially considered. Several genera occur on Tobago that are not known from the other islands to the north, but are now present on Trinidad. These are a peccary (Tayassu), a paca (Agouti), a Zygodontomys, and a squirrel closely akin to *Scuirus chapmani* of the latter island. In addition there are two opossums (Didelphys, Marmosa), an armadillo (Dasypus), an agouti (Dasyprocta), and, if we may trust the old French writers of two hundred and fifty years ago, a Megalomys was formerly found there.

Four fossil mammals have been hitherto currently recognized from the Antilles. The ground sloth (Megalonyx) which seems to have been common in Cuba during Pleistocene times, belongs to a genus which has not been found on the mainland south of Texas and Florida.

If its North American origin be admitted, this mammal is certain evidence of a former land connection between Cuba and Florida. Moreover, remains of a very similar species (*M. jeffersoni*) have been found in the peninsula of Florida. Probably the genus Capromys was contemporaneous in Cuba with this sloth. Part of the skull of an extinct species (*C. columbianus*), differing markedly, however, in the conformation of the palate from its living relatives, has been described from a cavern deposit of this island. The nearest living representative of the Cuban Capromys on the mainland is the much smaller *Procapromys geayi* from the mountains between La Guaira and Caracas, Venezuela. This is looked upon by Chapman as the possible mainland ancestor of the Antillean genus. At all events, these two fossil genera in Cuba point to migrations from both North and Central America (by way of Florida and Yucatan respectively).

The two other fossil species hitherto reported are Lesser Antillean. The first is a large rodent, *Amblyrhiza inundata*, now known from cavern deposits in the islands of Anguilla and St. Martin's. This animal is likewise considered of Pleistocene age; and, though doubtless related to the South American family Lagostomidae, including the chinchillas, is currently included with the North American genus Castoroides in the Castoroididae. Cope supposed the genus to have reached the Antilles from South America by way of the Windward Islands; but the present evidence does not seem to exclude the chance of its having come from North America along the same route with Megalonyx, provided, of course, that at that time the deep cleft now separating Anguilla from the Greater Antilles did not form a barrier.

The remaining fossil mammal is an undescribed species of Megalomys, briefly mentioned by Major, from Barbuda. This simply serves to extend the range of this recent genus to the more northern Lesser Antilles, throughout which it probably once ranged.

Turning now to the bats, we find at present recorded from the West Indies no less than thirty-one genera. On many of the islands local forms have developed which are sufficiently marked to be entitled to rank as local races or even species, although this matter is in part one of personal opinion. Since the trinomial better expresses such evident relationships between the forms on neighboring islands, I have, in the following pages, adopted this in preference to a binomial designation in cases where specimens have been personally studied, or where previous writers have shown preference for a trinomial title. Although the bat fauna of the West Indies may be considered fairly well known, there are many islands from which few if any species are recorded. It is noticeable that many of the better known species are cave haunters, and so are rather easily taken, once their caverns are discovered. The tree-dwelling bats, however, must usually be shot or captured as occasional chance may offer. Our knowledge of the distribution, especially of this latter class, is still therefore far from complete. For this reason the negative evidence as to the apparent absence of certain species must not be too strongly insisted upon. A singular instance is that of *Lonchorhina aurita,* originally described from a specimen without locality. Of the two additional specimens discovered in the fifty years since the first was made known, one came from Venezuela, and the second from Nassau Harbor, New Providence, Bahamas. The possible agency of a steam vessel might here be invoked, though the evidence at present points to the occurrence of the genus in the Lesser Antilles as well.

The apparent absence of certain genera is, however, very noticeable. Thus, there is no evidence that Pipistrellus or Dasypterus occurs anywhere in the West Indies. The widespread genus Myotis is apparently quite absent from the Greater Antilles, although in the Lesser Antilles a representative of the austral species *M. nigricans* is described from Dominica. The genus Rhogeëssa is perhaps to be looked for in Jamaica or Cuba, as it occurs on the neighboring mainland. Of the Emballonuridae, no representatives of Rhynchiscus, Saccopteryx, Balantiopteryx, Diclidurus, and certain rarer genera are known. Of common Central American Phyllostomidae, no record appears for Micronycteris, Tonatia, Phyllostomus, Anoura, Vampyrops, Chiroderma, the subgenus Dermanura of Artibeus; the Desmodontidae also seem to be unrepresented, as well as the Furipteridae and Thyropteridae.

Of the thirty-one genera of bats now known from the West Indies, no less than ten are peculiar to Antillea. Of these ten, three are represented in both the Greater and the Lesser Antilles, *viz.,* Monophyllus, Brachyphylla, and Ardops. The remaining seven so far as known are all peculiar to the Greater Antilles (including the Bahamas). These are Phyllonycteris, Reithronycteris, Phyllops, Ariteus, Erophylla, Chilonatalus, and Nyctiellus. These and other genera will be severally discussed below. It is interesting to observe that no genus of bats peculiar to the Lesser Antilles has been discovered, although our knowledge of the Chiroptera of these islands is still far from complete, — so much so, indeed, that practically nothing is known of the bat fauna of most of them.

Of species whose distribution throughout the Antilles is rather general, there are several. Of these *Noctilio leporinus*, owing to its fish-eating habits, might be expected to cross narrow stretches of sea, and so to spread from island to island. Its occurrence may therefore not be very significant from a geographical point of view. Probably the best known of the West Indian bats is *Artibeus jamaicensis*, with its races, more or less nominal. It might be thought that so large and strong a species would readily fly far over seas to populate outlying territory, but this supposition is not clearly borne out. The species is apparently absent from the Bahama archipelago, and its supposed occurrence at Key West, Florida, is unsubstantiated. Dr. K. Andersen, in his recent study of this genus, considers the Cuban form an admissible subspecies, derived probably from the Yucatan race. Typical *jamaicensis* occurs in the Honduras peninsula, St. Andrew's, Old Providence, and Jamaica, across through San Domingo and Porto Rico, and even so far east as St. Kitts, that is, slightly beyond the supposed geological boundary between the Greater and the Lesser Antilles (namely, the depression between the Virgin Islands and Anguilla. Dr. Andersen admits, however, that there "is absolutely no 'hard-and-fast' line" between *jamaicensis* and the race *palmarum*, from the latter of which he considers the race *praeceps* of the northern Lesser Antilles to be derived. The difficulty of determining the exact relationship of these bats may be gathered from the fact that *praeceps* of Dominica and Guadeloupe is indistinguishable from *aequatorialis* of Ecuador, which itself is merely a larger edition of typical *jamaicensis*! There can be no doubt, however, that this author is correct in deriving the races *palmarum* and *praeceps* from the race of the South American mainland, while the Greater Antillean representatives came by way of Central America.

The genera Nyctinomus and Molossus are probably the swiftest flying bats, yet it is remarkable that they show a differentiation in the West Indies that indicates a long continued local habitat. The common *Nyctinomus b. musculus* of the Greater Antilles (Jamaica, Cuba, San Domingo, and Porto Rico) is a race distinct from that of the adjoining mainland of North and Central America. Among the Bahamas, a further but less marked differentiation has occurred, represented by the race *bahamensis*; while in the Lesser Antilles, from Barbados north to at least St. Kitts and St. Bartholomew is the race *antillularum*. The fact that these two or three races should have thus become separated off, while the continental *brasiliensis* is the same from Patagonia to Texas, is very significant of the practical absence of recent migration of these animals. The same is true, but to a less degree, in the case of the West Indian race of *Molossus obscurus,* which appears to have become slightly differentiated from its prototype of South and Central America.

The case of Natalus is probably analogous in large measure to that of *Nyctinomus brasiliensis.* This is a genus of tropical America, and in the Antilles is known from San Domingo and Dominica. On the continent it ranges north into central Mexico. In San Domingo the slightly larger size of the representative of *N. stramineus* has caused it to be described as the race *major.* In Dominica, however, it seems quite the same as the form of the neighboring South American mainland whence it is supposedly derived. The genus is to be looked for on other of the Greater and Lesser Antilles, and from Jamaica probably rather than from Cuba, since the Yucatan land extension was perhaps slightly too far north to be available for this tropical species as a passageway to Cuba.

Of the three peculiar West Indian genera that occur in both the Greater and the Lesser Antilles, namely, Monophyllus, Brachyphylla, and Ardops, the first is widespread. Among the Greater Antilles it is known from Jamaica, Cuba, and Porto Rico, on each of which a local race has become differentiated. Doubtless it occurs on San Domingo as well. Among the Lesser Antilles it is represented by a local race on Santa Lucia and on Barbados; and an additional species is described, without locality, but is probably from one of the West Indies. Brachyphylla is recorded from Cuba, St. Vincent, and Barbados. The Cuban form is smaller, and is considered a species distinct from that of the Lesser Antilles. Possibly the genus is to be looked for on the intermediate islands. Ardops, with the related genera Phyllops and Ariteus, are doubtless to be considered as a unit in their geographical relationship. Ardops is recorded from Haiti in the Greater Antilles, and from Montserrat, Dominica, and Santa Lucia in the Lesser Antilles. In each of these islands a local form has become differentiated. The closely related Phyllops seems to be the representative of Ardops in Cuba, and in Jamaica its place is similarly taken by the kindred genus Ariteus. The correspondence between the distribution of the endemic genus Monophyllus and the Ardops-Phyllops-Ariteus group is therefore very striking, despite the evident gaps in our knowledge. No representative of Brachyphylla is yet known from Jamaica. It seems very significant, however, that this "most primitive of the Stenodermines" should occur with the genus Monophyllus on Barbados, formerly supposed to be a good example of an 'oceanic' island. The fact that the genus is yet known from but three of the Antilles, and that it occurs here with other endemic genera, may indicate that it is a survivor in these islands of a primitive genus whose range was once more extensive. The present distribution of the five genera considered may thus indicate either that they are survivors of an ancient fauna that was endemic in Antillea (including the Greater and Lesser Antilles as a continuous land mass), or that they reached these islands by one or more land bridges from Central or South America after which their continental prototypes became extinct. In either case it is probable that Phyllops and Ariteus have become latterly differentiated from the Ardops stock, in Cuba and Jamaica respectively.

The bat fauna of the Greater Antilles is much better known than that of the Lesser Antilles; nevertheless, it is undoubtedly true that the number of genera is greater in the former. Of those known from the Greater Antilles (including the Bahamas), but not from the Lesser, are these fifteen: Chilonycteris, Mormoops, Otopterus, Lonchorhina, Vampyrus, Phyllonycteris, Reithronycteris, Erophylla, Chilonatalus, Nyctiellus, Eptesicus, Nycticeius, Lasiurus, Mormopterus, Eumops. From this list are excluded Phyllops and Ariteus as being the representatives on Cuba and Jamaica respectively of the genus Ardops, just considered. The genus Lonchorhina is known from three specimens, one from Venezuela, one from New Providence, Bahamas, and one without locality but probably the Lesser Antilles.

The genera Peropteryx, Pteronotus, and Myotis are as yet known in the West Indies from the Lesser Antilles only, which they have evidently reached from South America; for these island forms are closely allied to those of that mainland and Trinidad, or are identical with them. The genus Glossophaga is represented in the southernmost Lesser Antilles by the species *longirostris* of northern South America; while in the Greater Antilles there is in Jamaica what is probably a race of *G. soricina.* There is evidence that the latter race also occurs in the Bahamas. The South and Central American species *Artibeus planirostris* is also represented in Grenada by a local race, *grenadensis,* evidently allied to that of the neighboring mainland. It is thus evident that these bats of the Lesser Antilles are of South American origin. The genera of the Greater Antilles will be considered in further detail.

The genus Chilonycteris is found in Jamaica, Cuba, San Domingo, and Porto Rico, in each of which there occur together the two species *C. macleayii* and *C. parnellii,* except in San Domingo where the latter has not yet been collected. There can be little doubt of its presence there, however. Of these two species, *C. macleayii* seems to be most nearly related to the continental *C. personata,* whose range is from Brazil north at least to Guatemala; *C. parnellii,* on the other hand, is nearer to *C. rubiginosa,* whose range is probably coextensive with that of *C. personata* on the mainland, where it is known from Brazil to Mexico. It seems strange that neither species should have yet been found in the Lesser Antilles, although *C. rubiginosa* is known from Trinidad. Among the Greater Antilles, each has developed a peculiar race on each of the larger islands. The race of *C. macleayii* found in Jamaica (*grisea*), is considered by Rehn to be the best marked of any of the subspecies; while the same seems to be true to a lesser degree of the Jamaican race of *C. parnellii.*

The case of Mormoops is somewhat similar to that of Chilonycteris. It is known as yet from Jamaica, Cuba, San Domingo, and Porto Rico, of the West Indies. The Jamaican species *M. blainvillii* is peculiar to that island, but in the other islands the subspecies *cinnamomea* takes its place. This differentiation is somewhat paralleled by that of its continental prototype, *M. megalophylla,* of which a northern subspecies is recognized in northern Mexico and southern Texas. Although the latter species ranges through northern South America to Trinidad, it is still unknown from the Lesser Antilles, indicating, possibly, that its extension thus far to the eastward took place mainly after the land connection with these islands had become destroyed.

The distribution of the genus Otopterus in the West Indies seems somewhat similar, except that it is known from the Bahamas as well as from the larger islands of the Greater Antilles. It has not yet been reported from Porto Rico, where, nevertheless, it may confidently be expected. So far as known, Otopterus is not found south of Guatemala, whence it ranges north into southern and Lower California. Its Antillean distribution is therefore of unusual interest, since, if we assume that its range has always been north of Panama, there is no way of its having reached the Lesser Antilles through a land connection from South America. That it does not pass eastward of Porto Rico is therefore quite what would be expected, if the deep cleft between the Virgin Islands and Anguilla is considered to have been the barrier between the two chains of islands. In Jamaica, Cuba, San Domingo, and the Bahama archipelago, respectively, local races of the single species *O. waterhousii* have been developed that differ but slightly among themselves. Apparently the Jamaican form, in its smaller foot and skull is nearer the continental *O. mexicanus* than the larger-skulled races from the other islands. That the West Indian Otopterus should be well distributed in the Bahamas yet wholly absent from the Florida peninsula and Gulf States directly west, is evidence that these islands have been connected recently with the Greater Antilles. If the theory of distribution through the agency of wind and chance is to obtain, here is an excellent opportunity for it to operate, since the prevailing trade wind would waft such wanderers to the east coast of Florida, where the climate and other conditions would be in part similar.

The subfamily Phyllonycterinae, so far as known, is peculiar to the Greater Antilles. Of its three genera, Reithronycteris and Phyllonycteris are apparently confined to Jamaica and Cuba respectively. Each is represented by a single species, and both are considered rare. These two genera are closely related, and seem to have become differentiated on the two islands from a common stock, doubtless of Central American origin. The third genus, Erophylla, has not yet been discovered in Jamaica, but is represented by slightly differing local races in Cuba, San Domingo, Porto Rico, and the Bahaman archipelago. Should it eventually be found in Jamaica as well, its distribution in the Antilles would correspond closely with that of Chilonycteris, Otopterus, and Chilonatalus. From the fact that Erophylla is unknown from the mainland, it may be assumed that, like the two other genera of the subfamily, it either reached these islands by land tongues from Central America, where it has since become extinct, or it has arisen as an endemic genus.

Further investigation will probably show the range of the genus Chilonatalus to be practically coextensive in the West Indies with that of Otopterus. It is now known from Old Providence Island, Jamaica, Cuba, and the Bahamas (Watling's Island and Great Abaco). Its presence is to be expected in San Domingo and probably Porto Rico. It has no known representative on the mainland, but is closest related to Natalus. The latter genus, though recorded at present from but two of the West Indies (Dominica and San Domingo) is likely to be found on other of the islands, particularly Jamaica and the more southern Lesser Antilles. The Natalus of San Domingo is larger than the continental races from which it is undoubtedly derived. That of Dominica, however, does not seem different from that of the neighboring mainland of South America. In view of the apparent absence of the genus Natalus from Cuba, it may be suggested that it is represented on that island by Nyctiellus, which in external characters is considered the least specialized of the Natalidae, although the skull and teeth have become considerably modified.

Although Chilonatalus and Natalus have not hitherto been found inhabiting together the same island, the fact that the former is found in Jamaica, Cuba, and the Bahamas, while the latter occurs on the intermediate island, San Domingo, and in the Lesser Antilles, is evidence that the two genera reached these islands already fully differentiated, and that Chilonatalus is not to be considered the representative of Natalus in the islands where it is now known. More likely the continental prototype of Chilonatalus was a Central American bat that has since died out. Moreover, the presence in Cuba of the peculiar genus Nyctiellus, occurring here at the same time with Chilonatalus, suggests that it is a derivative of Natalus. Undoubtedly Chilonatalus reached the Greater Antilles by land connection from Honduras to Jamaica, and either thence, or by way of Yucatan, to Cuba, and eastward to the Bahamas. Its presence on Old Providence Island is further evidence of the former land-bridge between the Honduras peninsula and Jamaica.

The Vespertilionidae offer several peculiarities of distribution. The absence of Myotis from the Greater Antilles has already been noted, and is readily to be explained from the fact that none of the North American species is known to range quite far enough south to have enabled it to spread on to the Yucatan promontory, and so to the Greater Antilles, at such time as a land connection existed. At all events it can hardly be doubted that at that period none of the North American species had extended quite far enough to the south to enable them so to cross. On the other hand, the tropical species *M. nigricans* had reached the Lesser Antilles from South America, and is now known from Dominica, where it has become slightly differentiated (*dominicensis*). Since the species ranges north into southern Mexico (Chiapas), its presence might be expected in Jamaica; but the fact that it has not yet been discovered there indicates that it may only recently have extended to Mexico.

The genus Eptesicus is known from Cuba and from New Providence in the Bahamas. On the former island is the large, richly colored race *cubensis*, closely related to *E. fuscus miradorensis* of Mexico and Guatemala. This fact indicates that the Cuban bat reached that island by way of the Yucatan connection, rather than from Florida. With this conclusion in mind, the occurrence of the very small *E. f. bahamensis* in New Providence, Bahamas, is somewhat of a surprise, in view of the large size of the tropical *miradorensis* and *cubensis*. May it not be possible that the Bahama brown bat is an offshoot of the small *E. propinquus*, found in Guatemala and Nicaragua? The status of this rare bat is still somewhat in doubt. Miller, in 1897, considered it a race of *E. fuscus,* but at the same time expressed the opinion that it might prove to be a distinct species. If the latter view be accepted, it would be possible to assume that the Bahama brown bat reached its present home by way of a land connection from Honduras to Jamaica and San Domingo. Further information as to the bat fauna of the latter island may throw light on this question.

It is remarkable that the genus Nycticeius, found elsewhere in America over the southeastern United States only, should also occur in Cuba. The recent discovery of a bat in East Africa, pronounced by Mr. G. S. Miller a typical Nycticeius, is of extraordinary interest in this connection. It is a fact probably quite in line with the presence of the molossoid genus Mormopterus in Cuba, Peru, and southeastern Africa, Madagascar, and Mauritius. A similar case is perhaps that of the occurrence in British East Africa of the bat genus Laephotis, nearly identical with the South American Histiotus. These and other facts point strongly to the conclusion that there was formerly a land connection between Africa and eastern South America, by means of which such an interchange of tropical genera was made possible. This view is ably supported by von Ihering from a study of marine littoral molluscs of the Tertiary and Cretaceous. Ortmann (1910) has recently reviewed his work, and writes that "the *Archhelenis-theory* of von Ihering has now received so much support from various sides that we may regard it as firmly established with regard to its general correctness. Stated in broad terms, this theory assumes a former land connection between Africa and South America, which is rather old. This connection is the last remnant of a large southern continental mass (South Atlantis, Gondwana-land), which existed since the beginning of the organic history of the earth (Cambrium), which was broken to pieces at different times, and the remnants of which are now found in Australia, India, Africa and Brazil. The separation of Brazil from Africa was the last step in the dismemberment of this old continent, an event which is placed by most writers toward the end of the Mesozoic era, although some have admitted the possible continuation of Archhelenis into the beginning of the Tertiary." Ortmann disagrees with von Ihering's conclusion that this land connection persisted into the Eocene.

The evident relationship of Solenodon to the West African Potamogale and the Madagascan Centetes may also point to a community of origin and a continuity of habitat in the past. But it is not necessarily to be assumed that the genus reached the Antilles from Africa or a southern land mass by any such direct connection, for present evidence is quite as good that it came by way of the Central American land tongues to these islands.

As for the bat genus Nycticeius, it is possible that it was formerly more widespread in America, and is now persisting in Cuba and the southeastern United States only. Its occurrence in Cuba alone of the Antilles may indicate a former connection with Florida; the same perhaps by which the ground sloth, Megalonyx, apparently a North American genus, reached the island. Possible, too, Nycticeius, as well as Mormopterus and Solenodon reached Cuba through the Yucatan bridge, at a time when Jamaica had already become separated, thus accounting for their apparent absence on the latter island.

The genus Lasiurus occurs in Jamaica, Cuba, and the Bahamas (New Providence). The Cuban species is brightly colored, like the Mexican race, from which it is probably derived; but the relationships of the Bahama red bat are not satisfactorily determined. Further investigation may show that this genus is found in the other Greater Antilles.

Bats of the family Molossidae occur throughout the West Indies. The species *Nyctinomus brasiliensis* of the mainland is represented by slightly characterized races in the Greater Antilles, the Bahamas, and the Windward Islands, respectively. On both Cuba and Jamaica occurs *N. macrotis*, a species of the 'Nyctinomops' group, which has not been elsewhere found in the West Indies. This distribution seems to be exactly matched by that of the genus Eumops. Thus, on Cuba is found a bat apparently indistinguishable from the *E. glaucinus* of the adjacent mainland, while on Jamaica its place is taken by the closely related species, *E. orthotis*. Doubtless the land tongues connecting Cuba and Jamaica with Yucatan and Honduras respectively, allowed these bats to reach their present homes.

The case of Mormopterus, known in America from Cuba and Peru, has been already discussed. It may eventually be found in Jamaica.

The genus Molossus is represented by three species. The first seems to be a slightly smaller race of the continental *M. obscurus*, and probably occurs throughout the West Indies, except apparently the Bahamas. A small species occurs in Cuba whose relationships are still uncertain, while in the southern Lesser Antilles is found the South American species, *M. crassicaudatus*.

Summary.— The foregoing survey of the known mammalian fauna of the West Indies shows but three Antillean genera that are common to both Greater and Lesser Antilles. These are Brachyphylla, Monophyllus, and Ardops with its Cuban and Jamaican offshoots, Phyllops and Ariteus. The general distribution of these bats may indicate that at one time the land area of the Greater and Lesser Antilles was more or less continuous, or that the same genus reached the two groups from Central and from South America respectively, and then spread in both directions. The former supposition is the more probable, and is borne out by the facts of the distribution of reptiles (Barbour, 1910). Other species whose distribution is continuous throughout the Antilles are: *Noctilio leporinus, Artibeus jamaicensis, Nyctinomus brasiliensis,* and *Molossus obscurus.* Of these, all but the first are represented by local races, a study of which tends to show that they have reached the Antilles from both ends of the chain simultaneously.

The distinctness of the mammalian fauna of the Greater Antilles from that of the Lesser is very striking. The terrestrial species of the former seem to be entirely derived from North and Central America, while those of the Lesser Antilles are equally of South American affinity. The two faunae meet at the northeastern corner of the Antillean chain. Similarly the bats of the two groups comprise many genera or species peculiar to each. Thus Chilonycteris, Mormoops, Otopterus, Erophylla, Chilonatalus, Eptesicus, Lasiurus, and Eumops are present on two or more of the Greater, but are unknown from the Lesser Antilles. On the other hand, Peropteryx, Pteronotus, *Glossophaga longirostris, Artibeus planirostris grenadensis, Myotis dominicensis,* and *Molossus crassicaudatus* are Lesser Antillean bats that have very clearly reached those islands from South America, and are unknown in the Greater Antilles. The relations of the Lesser Antillean islands to each other are apparently much simpler than those of the Greater. Thus, the mammals of Tobago are very similar to those of Trinidad, though fewer in species; and proceeding northward, the known species are all such as would be expected to have come over a land bridge from northern South America. There is also a diminution in the number of genera represented as one proceeds northward, although, owing to our imperfect knowledge, it is still impossible to state this difference accurately. Dominica seems to be the best known of any of the Windward Islands as regards its bat fauna, but as yet only nine species are recorded.

The former land connections and faunal migrations of what are now the Greater Antilles seem to offer much more complex problems. Thus, Cuba must have received accessions largely through a Yucatan land bridge. Some also may have come from Florida by way of another land connection. Such, for example, is probably Megalonyx, and perhaps the bat genus Nycticeius. A more intimate knowledge of the fauna of San Domingo is imperative for the determination of the extent to which migration took place between that island and Cuba. There is evidence that the connection became dissolved before that with Yucatan. This might account for the apparent isolation in Cuba of Megalonyx, the long-tailed species of Capromys, and the bats Nycticeius, Nyctiellus, Mormopterus. Perhaps also the apparent absence of a race of *Eptesicus fuscus* from the other islands (? except Bahamas) is explicable through the short duration of a Cuba-San Domingo connection.

Notwithstanding the number of evident similarities between the fauna of Cuba and that of Jamaica, these need not indicate any direct land connection between the two islands. Indeed, the evidence seems to point to their long isolation. Of the bat genera common to both, Chilonycteris, Mormoops, Otopterus, Chilonatalus, Lasiurus, Nyctinomus (Nyctinomops group), and Eumops are not known from the Lesser Antilles. Two species of Chilonycteris occur together on both Cuba and Jamaica, as well as on other of the Greater Antilles. Both have probably reached these islands through separate land connections by way of Yucatan and the Honduras peninsula respectively; and by a similar route it is probable that the other genera came to each. Evidence for this assumption is the apparent absence in Cuba and other of the Greater Antilles of the three following bats known in Jamaica: *Vampyrus spectrum, Hemiderma perspicillatum,* and *Sturnira lilium.* Probably the range of these tropical species never extended sufficiently far north to permit of their crossing by a land bridge to Cuba by way of Yucatan, whereas it did allow of their reaching Jamaica by way of the supposed Honduras land tongue. We may assume, further, that the connection with San Domingo had disappeared by the time they reached Jamaica.

The genus Phyllonycteris of Cuba may be represented in Jamaica by the endemic Reithronycteris, just as Phyllops of Cuba seems to be represented by Ariteus in Jamaica. The fact of these genera having been thus independently developed on the two islands from some common stock seems to indicate a long isolation.

On the other hand, there are several species which are practically identical on the two islands. Thus, *Chilonatalus micropus* of Jamaica is considered the same as that of Cuba; *Nyctinomus b. musculus* and *N. macrotis* are the same on both; and the Eumops of Cuba, considered the same as *E. glaucinus* of the mainland, is not greatly different from *E. orthotis* of Jamaica. These wide-ranging bats of the family Molossidae, however, would be less expected to show local differentiation. All these five species may be assumed to have reached Cuba and Jamaica by separate land connections to each island. The fact that *Nyctinomus macrotis* and the genus Eumops are still unknown from the other islands may indicate that their arrival took place after both Cuba and Jamaica had lost connection with the other Antilles. Too much stress must not be laid on this negative evidence, however. The absence of Eptesicus from Jamaica, too, may be merely apparent. A summary of the known bat fauna of Cuba and Jamaica gives the former twenty-one and the latter nineteen species. There are six genera in Cuba that seem to have no Jamaican representative, and four Jamaican genera that are unrepresented in Cuba.

Of the connection of Cuba with Haiti and San Domingo there can be no doubt, from the many genera or even species of animals that they have in common. Of mammals, such are Solenodon and Erophylla; perhaps too the long-tailed Capromys. It seems equally evident, however, that it has long been separated from the other Greater Antilles. Certain facts point also to a connection by way of Jamaica, with San Domingo, and thence to Porto Rico and the Bahamas, a land bridge that may have persisted after that between San Domingo and Cuba had disappeared. Very significant here is the distribution of the short-tailed members of the genus Capromys. None is known from Cuba, but closely allied species are found in Swan Island, Jamaica, and the Plana Keys, Bahamas. Doubtless there was formerly a species also in San Domingo, if we may so identify the "Cori" of Oviedo. There is no very adequate evidence that any of the other animals described by Oviedo from this island were long-tailed Capromys. If they were, they may have been specimens brought from Cuba, or they may have been Plagiodontia, the significance of whose isolated habitat here it is now difficult to see. At all events, the facts point to a land bridge from Central America by way of Jamaica and San Domingo, over which the short-tailed Capromys reached the Bahamas. In like manner may perhaps be explained the occurrence of a bat in the Bahamas similar to *Glossophaga soricina antillarum* of Jamaica. The genus is unknown from Cuba, and indeed, for that matter, from San Domingo; but its occurrence on the latter island may be postulated. According to Andersen, a study of the genus Artibeus indicates that the San Domingo and Porto Rico representatives of the species *jamaicensis* are identical and differ from the Cuban race, whose affinities are nearer the large Yucatan form. I have already suggested that the occurrence of a small Eptesicus in the Bahamas may be explicable by supposing that it was derived from the small Central American *E. propinquus,* by way of Jamaica and San Domingo. Further research, however, must establish its presence or absence on these intermediate islands. It may be argued that if this supposed connection allowed certain species to reach the eastern Greater Antilles, independently of a connection by way of Cuba, why did not others, such as Solenodon, Plagiodontia, Erophylla, reach Jamaica by the same route? It is possible that such a movement did take place; but at this date it might be out of the question to determine whether a Jamaican species had come directly from the continent to the west, or from Antillea to the east. Perhaps by this latter route came such now wholly West Indian genera as Monophyllus, Ariteus, and Reithronycteris. On the other hand, the main movement would naturally be from the west toward the less thickly populated lands to the east.

In conclusion, it appears that the present evidence afforded by the distribution of West Indian mammals in the main corroborates the current hypothesis that the fauna is derived in part from northern South America, and in part, by means of probably at least two land bridges, from North and Central America. A few genera are peculiar, and found throughout the chain. These may represent forms that were formerly wide ranging on the mainland and spread throughout the chain, either from both ends, or from one end provided the present island series was then a continuous land mass; on the other hand they may have developed on an Antillean continent, and since become isolated on the several islands through a depression of this continent. To the Greater Antilles, two main land bridges are indicated: one by way of the Yucatan peninsula to Cuba; a second by way of the Honduras peninsula to San Domingo and the Bahamas. Subsidiary connections probably occurred between Cuba and Florida, and Cuba and San Domingo. Between the latter and Jamaica there was doubtless a land connection, as well as between Jamaica and Central America. As shown by Alexander Agassiz in his *Three Cruises of the Blake,* published in 1888, there is at a comparatively shallow depth a bank connecting Honduras with Swan Island and other islets, Jamaica, and the southwestern arm of San Domingo. The five hundred fathom line would practically include this connection, as well as the islands of Porto Rico, Virgin Islands, and the Bahamas. Between Cuba and San Domingo, however, is a greater depth, amounting to "not less than eight hundred and seventy-three fathoms." This cleft may well have developed to form the supposed barrier between Cuba and San Domingo. Between the Greater and the Lesser Antilles the deep valley between the Virgin Islands and Anguilla is considered the barrier that prevented the interchange of many of the South American types of the Lesser Antilles and the Central American derivatives of the Greater Antilles.

Annoted List.

DIDELPHIIDAE.

Didelphis marsupialis insularis J. A. Allen.

Didelphis marsupialis insularis J. A. Allen, Bull. Amer. Mus. Nat. Hist., 1902, **16**, p. 259.

As stated by Dr. J. A. Allen in describing this opossum from Trinidad, "St. Vincent, Grenada, and Dominica specimens are similar, and were most likely derived from the Trinidad stock, having doubtless been introduced into these islands from Trinidad." The Museum collection contains six specimens from Trinidad and eight from Grenada, and a careful comparison of these corroborates Dr. Allen's view that they are identical. A single youngish example from St. Vincent, collected in 1903 by Mr. A. H. Clark, has the dorsal part of the supraoccipital bone considerably wider and slightly different in shape from that of the Grenada and Trinidad specimens, a condition perhaps due to youth. The skin of this specimen shows the melanistic phase, and has the long hairs of the body almost entirely black. The ears, however, are very slightly tipped with white, instead of being entirely black.

De Rochefort, writing in 1658, speaks of "opossums" as one of the five species of mammals known by him to be native to Tobago. Similarly Du Tertre, in the 1667 edition of his "Histoire Générale des Antilles habitées par les Français," Vol. 2, mentions having first met with the "Manitou" on Grenada. At that time the animal seems to have been unknown in the islands to the northward; for, in the previous edition of this work, written in 1654, Du Tertre makes no mention of it in the portion dealing with the native mammals of the French islands (chiefly St. Christopher, Guadeloupe, and Martinique). Apparently it was then common on Grenada; and a specimen was shown to him as a curiosity, and then thrown into the gutter, for, he says, no one eats them, not even the negroes. From this it seems very probable that its present occurrence on St. Vincent and Dominica is due to human interposition at a somewhat recent date. Mr. Austin H. Clark, who spent some months collecting among the Lesser Antilles in 1903, tells me that this opossum is found also on the larger Grenadines, (including Mustique, Bequia, Canouan, Union Island, Carriacou, and Isle Ronde). It has apparently become less common on St. Vincent and Grenada since the introduction of the mongoose. It is considered a great delicacy by the negroes of the present day, who esteem especially the hind-quarters and tail as being the sweetest meat. It is often caught by suspending a bunch of bananas over a hole dug in the ground about four feet across and the same in depth, into which the animal falls in attempting to reach the fruit.

MARMOSA CHAPMANI Allen.

Marmosa chapmani Allen, Bull. Amer. Mus. Nat. Hist., 1900, **13**, p. 197.

Marmosa grenadae Thomas, Ann. Mag. Nat. Hist., 1911, ser. 8, **7**, p. 514.

Two specimens from Grenada are identical in size and cranial measurements with a topotype of *M. chapmani* from Caura, Trinidad. They are, however, slightly paler cinnamon along the sides; but this is apparently not more than individual variation.

I have been able to compare with these specimens the type of *M. robinsoni* from Margarita Id., Venezuela, in the Museum collection, and find that, although the two species are quite the same in size, the latter is decidedly paler, with a smaller eye spot that does not extend so far posteriorly.

Thomas (1911) has just described as *Marmosa grenadae* the murine opossum of Grenada, from a specimen collected in 1886 and skinned out from alcohol. Owing to immersion in spirit, the color characters are unreliable, and Thomas states that the skull is as in the Trinidad species, which he here redescribes as *M. nesaea,* overlooking the name *chapmani* bestowed eleven years before on the same animal. There does not seem to be good ground for recognizing either of these names.

This little opossum seems to be not rare all over the island of

Grenada. We obtained one specimen in a trap baited with meat in the heavy forest at Grand Etang, 1800 feet; and the people in the lowlands were also well acquainted with it. Among the Grenadines, Mr. Austin H. Clark informs me that it occurs on Carriacou and Isle Ronde as well. Its local name is "manicou gros-yeux," in reference to the apparent size of the eyes due to the large black orbital spots. The possibility of its having been introduced from Trinidad is, of course, to be considered, although the likelihood of its having been carried to the small Grenadines, Carriacou and Isle Ronde, may seem rather small.

MEGALONICHIDAE.

Megalonyx rodens (Castro).

Megalochnus rodens Castro, Anal. Real. Acad. Cien., Habana, 1864, **1**, p. 58.

Notwithstanding the former doubt cast on the authenticity of the Cuban fossil remains of this extinct sloth, it is now certain that they were actually found on the island. The original specimen was from the province of Cienfuegos; and additional localities are now known, *viz.*, Cardenas and between Santo Domingo and Sagna. A discussion of these and other supposed Cuban remains of Equus, Hippopotamus, and Mastodon is given by Vaughan (1902). More recently Professor de la Torre (1910) has discovered additional remains of this animal, sufficient largely to reconstruct its skeleton. In his preliminary account of this find, he figures the teeth and claws, and mentions especially a locality in the Sierra de Jatibonico, where he personally excavated these bones from caverns, and found them associated with bones of a crocodile, which, he suggests, may have preyed upon the Megalonyx.

DASYPODIDAE.

Dasypus novemcinctus hoplites, subsp. nov.

Type.— Adult female, skin and skeleton No. 8116, M. C. Z., from the hills back of Gouyave, island of Grenada, September 7, 1910; collected by G. M. Allen.

General characters.— In external characters, similar to *Dasypus* *novemcinctus* from Brazil, but smaller. Skull smaller, with tooth-row decidedly shorter, due in part to the usual suppression of the last molar.

Description.— The dermal armor in the fresh specimen is flesh color, darkening slightly in the midline. It consists of the usual frontal shield, produced posteriorly between the ears, a scapular and a pelvic shield, with nine transverse movable bands between. The dorsal surface of manus and pes are closely covered with more or less hexagonal scales. The tail has twelve complete bony rings, succeeded by an armored tip 110 mm. long. From the posterior free edges of the transverse body rings project three or four short bristles from each scale; similar but more minute hairs are present at the posterior margins of the scales on the shields of body and tail. The ventral surface of body and limbs is set with transverse rows of small round dermal scutes that average about a centimeter apart. Each of these scutes is the center of a cluster of yellowish bristles which are longest on the throat and legs. Mammae four, two pectoral, two inguinal. Claws, four on the manus, five on the pes. Ears minutely scaly.

Skull.— Except for its smaller size, the skull of the West Indian armadillo is very similar in form to that of the mainland animal from Brazil. The premaxillaries, however, average slightly shorter in proportion, and are nearly as long, ventrally, as the distance from their posterior points to the first tooth, instead of greatly exceeding the distance, as is more usual in mainland specimens. The most notable and interesting peculiarity of this island race, however, is the tendency to the reduction of the number and size of the teeth, which thus produces a shortening of the entire tooth-row. The number of teeth in five specimens from Brazil is:— $\frac{8-7}{8-8}$; $\frac{8-8}{8-8}$; $\frac{8-8}{8-8}$; $\frac{8-8}{8-8}$; $\frac{8-8}{8-8}$. In the three specimens from Grenada the teeth are: —

No. 8116, $\frac{7-7}{8-7}$; No. 8117, $\frac{6-6}{7-7}$; No. 8118, $\frac{7-6}{7-7}$. It is the posteriormost tooth of the upper series that has become lost in all cases. This is clearly shown also in the single aberrant Brazilian specimen by the fact that on the left side there is a minute posterior tooth; but on the right side the corresponding position is blank, and the large seventh tooth is exactly opposite the seventh tooth of the left side. In all three Grenada specimens the small posterior tooth is permanently lost, so that the tooth row ends abruptly with the large sixth or seventh tooth. In No. 8118, it is also clearly the seventh tooth that has been lost on the right hand side, since the corresponding tooth of the left side is opposite the empty space. Moreover, this dropping out of the posterior members of the series increases the distance between the maxillopalatal suture and the end of the tooth row, causing a marked interspace in the Grenada skulls; whereas in mainland specimens the eighth molar but is very slightly in advance of the palatal suture. The usual rule of the more rapid evolution of the upper than of the lower jaw is also well illustrated by the fact that in no case has the number of lower teeth been reduced beyond seven, and in the type the eighth lower left tooth is still retained. In the island animal, also, the teeth are noticeably smaller in absolute size than those of the smallest of the Brazilian series.

Measurements.— The external measurements of the three Grenada specimens, taken in the flesh, and of an alcoholic specimen from Brazil, are:—

No.	*Locality.*	*Total length.*	*Tail.*	*Hind foot.*	*Ear.*	*Sex.*
8116	Grenada	678	320	82	37	♀
8117	"	638	310	80	37	♂
8118	"	615	290	75	32	♂
130	Para	696	325	84	38	—

The skulls of the type, and of No. 3699 from Brazil (in parentheses) measure respectively: — greatest length 85.5 (98); basal length, 71 (82); palatal length, 55.7 (65); zygomatic width, 35 (42); interorbital width, 22 (23); length of premaxillaries, 9 (13); anterior tooth to premaxillary, 9 (10); length from last molar to pterygoid, 19 (20); length of upper left tooth row, 19 (24); length of lower jaw, 66.5 (80); length of lower tooth row, 20 (25).

Of the three specimens of this armadillo obtained in Grenada, the type is fully adult, and probably of nearly maximum size. The two others are apparently full grown, but the sutures of the skull are not so nearly closed. Their skulls are even smaller than those of the type. A study of the nine-banded armadillos from Brazil in the Museum collection shows that there is more or less variation in size among fully grown animals, the smallest of which are very nearly the size of the larger female from Grenada. The average size is, however, much larger, and the cranial characters sufficiently striking. It seems best, nevertheless, to regard the island animal as a subspecies, both because of the probable intergradation, and because of the expression of relationship thus made possible.

An armadillo from Caparo, Trinidad, No. $\frac{7549}{5942}$, American Museum of Natural History, is clearly the same as the typical species of Brazil. It measured: — total length, 802 mm.; tail, 360; ear, 38.5. Skull, greatest length, 93; palatal length, 63; zygomatic breadth, 38.5;

upper tooth row, 25; lower tooth row, 25; last molar to end of palate, 19.4; palatals, 17; lower mandible, extreme length, 73.3; teeth, $\frac{8-8}{8-8}$.

Nomenclature.— According to Thomas (Proc. Zool. Soc. London, 1911, p. 141) Dasypus should replace the generic name Tatu, for this armadillo. The type locality of Linné's *Dasypus novemcinctus* is "America meridionali," and is generally taken to be the eastern coast of Brazil. Linné also describes as *Dasypus septemcinctus* an armadillo which is characterized by "cingulis septenis," and lives "in Indiis." Whether this name was actually based on specimens from the Antilles or not seems impossible now to decide. Certainly, however, the Antillean armadillo normally has nine bands; and it is more reasonable to suppose an error in Linné's locality than that his specimen was abnormal. The name *septemcinctus* is doubtless best considered as referring to the small armadillo of southeastern South America, which does have seven bands. The name was so used by Schreber (in his Säugetiere, vol. 2) and Gray. According to Thomas the animal should be known as *Dasypus septemcinctus* Linné.

In his "Handlist of the Edentate, Thick-skinned, and Ruminant Mammals of the British Museum" (1873) Dr. J. E. Gray recognized no less than seven species of the large nine-banded armadillos from the mainland of South and Central America, five of which he there describes as new. These are: *Tatusia granadiana, T. leptorhynchus, T. brevirostris, T. leptocephala, T. boliviensis.* He also recognizes *T. mexicana* of Peters, but ignores the latter's *T. fenestratus* of Costa Rica. His names are based mainly on minute and inconstant variations in the shape or arrangement of the head plates, and the outline of the lachrymal bone. These differences disappear on the comparison of even small series, so that it is currently considered that *Dasypus novemcinctus* of Brazil is the same as the Central American and Mexican animal. Gray's names *brevirostris* and *boliviensis* are both based on specimens from Bolivia, whence I have seen no material.

A series of ten skins and skulls from Panama, Costa Rica, and Yucatan, however, shows that the Central American animal, while essentially of the same size as the large Brazilian armadillo, is very readily distinguished by its absolutely much shorter palatal bones, which do not usually reach the level of the posterior tooth, and by the very marked inflation of the maxillary region of the skull directly in front of the lachrymal bones, as is best seen from the ventral aspect. In the Brazilian nine-banded armadillo, the palatal bones usually bow forward at least to the level of the posteriormost tooth; but in the Central American race there is commonly a space of from 1 to 3 mm. between the last molar and the palatal. In ventral aspect, the lateral outline of the skull is nearly straight, or slightly concave from the widest portion of the zygoma to the base of the rostrum, but in the Central American skulls this margin bows suddenly out at about the level of the sixth tooth, and forms a convexity that ends at the level of the second or third tooth. Peters (Monatsb. k. preuss. Akad. Wiss. Berlin, 1864, p. 180) described the nine-banded armadillo from Costa Rica under the name of *Dasypus fenestratus,* and pointed out the fact of its shorter palate, as well as other less important cranial differences, as contrasted with the typical species. In the same paper he also described *D. mexicanus* from Mexico. These two names, however, appear to be synonymous, for the Mexican animal is essentially similar to that of Costa Rica. Since the latter is first described, it will therefore be proper to speak of the nine-banded armadillo of Mexico and Middle America as Dasypus novemcinctus fenestratus Peters. In this connection, it is interesting to note that four specimens from Mexico in the Museum collection have but eight thoracic rings instead of the nine usually found.

As nearly as can be judged from Gray's figure of *T. granadiana* (Hand-list of Edentata, 1873, pl. 2, p. 2) this name is probably synonymous with *D. novemcinctus,* as the New Grenada specimen seems to show a less swollen malar region than does his figure of *mexicana.* The greater length of the palate in the Central American race is evident from the following measurements: —

No.	*Locality.*		*Greatest skull length.*	*Greatest length of palatals.*
130	Para		89	19.5
998	Brazil, Sta. Rita		98	19.8
1030	" "		93.5	22.3
1003	" "		96	18.5
3699	Brazil		100.5	20
		Average	95.4	20
2835	Panama		99.5	17.5
12330	Costa Rica		101.	17.5
12325	"		97.5	15.4
12329	"		98	16.5
12326	"		98	16.2
		Average	98.8	16.6

Antillean Distribution.— There is no evidence to show that the Antillean armadillo ever occurred naturally to the northward of Grenada. De Rochefort, writing in 1658, on the natural history of the Antilles, gives the "Tatou" as a native of Tobago, and notes that, while some armadillos are as large as foxes, "ceus qui sont à Tabago sont beaucoup plus petis" (1658, p. 123). Evidently, then, the Tobago armadillo was small, as is the Grenada animal. Again, Du Tertre, writing in 1654, of the natural history of the French Islands, St. Christopher, Guadeloupe, and Martinique, does not mention its occurrence; but in the 1667 edition of this work, written after he had visited Grenada, he includes it, with the remark that he had never seen it until he visited that island, where it was then common. Its flesh was highly esteemed, and the animal was much hunted with dogs. He adds, in substance, that Grenada is the only one of the islands inhabited by the French where this little animal can live, and that many people have endeavored to transport it alive to Martinique, but without success. For if they even take it as far as St. Vincent, its strength fails it, and most of them die on the voyage. If even the strongest live until they reach Martinique, they die as soon as they touch the ground. This statement, however, was doubtless a more or less fanciful explanation of the absence of the "tatou" from the other islands; for Labat, in 1742, disproves it by asserting that he himself saw one in 1704, alive and well, that had been brought from Grenada to Martinique at Fort St. Pierre. He had never tasted its flesh on Martinique; but in Grenada in 1700 he had several times eaten it, and speaks of it as white, fat, and delicate (Labat, 1742, **3**, p. 19).

On Grenada it is now confined to the rough country, covered with primeval forest, on the hills of the region about Grand Etang, and thence to the hills back of Gouyave, on the west coast. Its flesh is much esteemed by the negroes, who capture it by means of a deadfall constructed over the armadillo's runway among the thick undergrowth. This consists of a small palisade of stakes for about a yard on each side of the trail, above which a number of heavy stones are suspended on a couple of logs placed lengthwise with the runway, and held by an ingenious series of levers and notched sticks, on the "figure 4" principle. This deadfall is sprung by the animal tripping a slender trigger in passing between the palisades of stakes. The traps are usually visited every other day, and one man may catch one or two tatous in this time from his six or eight traps. It is also sometimes hunted with dogs at the present day; and Mr. John Branch, of

Grenada, tells me that he has in this way captured five in a single night in the forest back of Victoria.

Mr. Austin H. Clark tells me that several years previous to 1904 the armadillo was introduced from Grenada into Carriacou, but has not been met with there since. He suggests that this island may be too dry for its existence.

CERVIDAE.

ODOCOILEUS.

Gundlach (1866–7, p. 40) says that the deer is not native, but has been introduced into Cuba. It is not mentioned by Ramon de la Sagra (1840) in his work on Cuban mammals.

LEPORIDAE.

ORYCTOLAGUS CUNICULUS (Linné).

Lepus cuniculus Linné, Syst. Nat., 1758, ed. 10, **1**, p. 58.

The common hare has been introduced into Barbados, and into Balliceaux in the Grenadines. Mr. Austin H. Clark writes (in 1903) that on Barbados it is becoming rare, as the mongoose preys on the young; but it is still very common on Balliceaux. What is presumably the same animal was introduced long ago into Guadeloupe from Europe. Du Tertre says of it, in 1654, that it had then become very abundant, and made burrows to the depth of two or three feet, where the hard volcanic "tuf" was encountered through which it was unable to dig. He observes that the rats eat the young, and often kill the old ones as well, from which he predicts their eventual extermination.

Feilden (1890) states that, according to Dr. Sinclair Browne, they were first brought to Barbados from England in 1842 by Thomas Trotman; and were bred in an enclosure on the Bulkeley estate, St. George's Parish. A heavy rainfall finally demolished part of the enclosure and allowed the hares to escape. They increased rapidly; and Dr. Browne recalled a man in St. Phillip's Parish who, about 1870, annually shot two or three hundred. By 1890, their numbers were much reduced, due, according to Feilden, in part to the possession of firearms by the negroes, but chiefly to the mongoose.

The European rabbit (*Lepus europaeus*) is said to have been introduced into Barbados; but, although they increase rapidly at first, the mange soon attacks the old ones, and the rats kill the young before they are large enough to leave their burrows.

AGOUTIDAE.

DASYPROCTA ALBIDA Gray.

Dasyprocta albida Gray, Ann. Nat. Hist., 1842, **10**, p. 264.

Dasyprocta cristata Auct.

Since 1876 the agoutis of the Lesser Antilles have been tacitly referred to *Dasyprocta cristata* (Desmarest), following Alston, who, in his paper on the genus (Proc. Zool. Soc. London, 1876, p. 347–352) wrote that West Indian specimens seemed identical with others which Waterhouse had identified with Desmarest's species. Desmarest's name dates from 1816, when he published the description, without locality, in the Nouvelle Dictionnaire, **1**, p. 213. Later, however, in his Mammalogie (1820) he states that the species was known from two specimens only that came from Surinam, and were living in captivity at the Paris Museum. Desmarest knew the West Indian species, which he considered the same as his *D. acuti*, found in Brazil, and Guiana. The name *cristata* is therefore referable to some one of the continental species of Dasyprocta. I have been able to examine skins and skulls of but five Antillean agoutis,— two from Sta. Lucia, and one from St. Vincent, in the collection of the Museum of Comparative Zoölogy, and a single one each from the islands of Montserrat and St. Kitts, kindly lent by the U. S. National Museum. I have also studied material from Trinidad in the collections of these Museums and of the American Museum of Natural History. From this small series it is difficult to draw very certain conclusions, but it seems evident that the St. Vincent and Sta. Lucia specimens at least are readily distinguishable from those of Trinidad. These latter may be assumed as representing more or less closely the mainland animal, probably the same as that which Thomas has named *D. rubatra*. The final disposition of the name *cristata* remains still to be worked out.

In 1842, J. E. Gray described and named as new an agouti from the island of St. Vincent. This was apparently an albinistic individual, as shown by the brief diagnosis: "whitish gray, nearly uniform, the hair of the back elongated, white at the base .... Size of a guinea-pig, *Cavia cobaya*." Later writers have ignored this name, or considered it synonymous with *D. cristata.* Apparently, however, the St. Vincent agouti is a valid race of the Trinidad species, and to it therefore Gray's name will apply. The specimen in the collection of the Museum of Comparative Zoölogy is an adult female, procured in February, 1904, by Mr. Austin H. Clark. It seems to represent a smaller animal than that of Trinidad, with a hind foot of about 95 mm. instead of 109 or 110 as in the latter. The skull is markedly smaller, with a shorter and more sharply tapering rostrum, shorter nasals, and a shorter median frontal suture. The maxillary pit at the inner side of the antorbital foramen is smaller, and circular, instead of large and oval, as in the Trinidad animal. The lachrymal canal opens on the upper side of this pit. The skull measures as follows (in parentheses are measurements of a Trinidad skull): — greatest length, 94 (104); basal length, 69 (76); palatal length, 34 (42); median length of nasals, 31.4 (36.5); median length of frontal suture, 38 (44); zygomatic width, 48 (48); upper diastema, 24.5 (29); upper cheek teeth (alveoli), 15.5 (17). The skin accompanying the St. Vincent skull seems redder than usual, but can be practically matched with Trinidad skins.

DASYPROCTA ANTILLENSIS Sclater.

Dasyprocta antillensis Sclater, Proc. Zool. Soc. London, 1874, p. 666, pl. 82.

Two skulls of the agouti from Sta. Lucia seem to show that it is distinct from that of St. Vincent, or of Trinidad, although the skins do not appear to differ.

In 1874, Sclater described two living agoutis received from Sta. Lucia by the Zoological Society of London. These he compares with *D. punctata* of Central America; and notes a specimen from St. Vincent in the British Museum, which he considers the same as his Sta. Lucia animals. He proposes to call the West Indian animal *D. antillensis,* and gives a plate of it. Since his description was evidently based on Sta. Lucia specimens, the name *antillensis* may stand for the agouti of this island. It is nearly the same in size as the Trinidad agouti, but with notably shorter nasals, which tend to be narrower, and to taper slightly at the distal end. The rostrum is noticeably shorter; and the incisive foramina are prolonged posteriorly to reach the maxillo-intermaxillary suture, instead of ending some 3 or 4 mm. anterior to it. The pit in the maxillary bone at the inner side of the antorbital fossa is smaller and more nearly circular.

Among the material in the collection of the U. S. National Museum is a single skull (No. 14010) of an agouti from the island of Montserrat, collected by Fred Driver, and received May 20, 1902. It is that of a female, and the condition of the basi-occipital suture shows that it is not fully adult, though probably mature. This specimen is slightly smaller than the skull of *D. albida* of St. Vincent, and differs remarkably in the narrowness of the zygomata and brain-case, narrow palate, and contracted opening of the posterior nares. The conformation of the palate is especially striking, for the posterior prolongations of the maxillaries are so reduced as to be almost absent along the posterior half of the alveolar border, instead of broadly tapering to the inner angle of the last molar, as in all the other specimens examined. The palatal bone therefore practically occupies the full width of the posterior half of the palate. The antorbital foramen is much reduced in vertical extent as compared with specimens from other islands; and the maxillary pit is elliptical in outline, and smaller than in Trinidad skulls. The incisive foramina are long, and reach the maxillo-premaxillary suture.

This skull measures as follows:— greatest length, 90; basal length, 67; palatal length, 33; length of nasals, 30.5; median length of frontal suture, 37; zygomatic breadth, 42; mastoid breadth, 32; diastema, 22; upper molar row (alveoli), 18; lower molar row (alveoli), 19; anterior width of palate between inner borders of alveoli, 7.6.

The structure of the palate in this single specimen is so different from that of any other agouti I have examined that it may be merely an abnormality; so that, in view of this possibility, and the fact of its being not fully adult, it seems best to await additional specimens before naming it.

A skull from the island of St. Kitts, also in the U. S. National Museum, has very broad short nasals, but is evidently immature, and somewhat abnormal owing to a fracture of the premaxillary, and the loss of the upper right incisor. Probably a series of agoutis from the various islands of the Lesser Antilles would show that they had become slightly differentiated on all or most of them.

Antillean Distribution of Dasyprocta.— The agouti must formerly have been rather generally distributed throughout most of the Lesser Antilles. De Rochefort, in 1658, included it among the five species of mammals listed as native to Tobago, and gives a crude picture of one sitting on its haunches, and eating leaves which it holds in its forepaws. It is still found on Grenada, where, however, it is confined to the small area of primeval forest yet remaining among the hills of the interior. Here it has become excessively scarce of late years, due, as some think, to the mongoose killing the young. None of the native hunters with whom I spoke in Grenada seemed to think it possible to procure specimens. Mr. Austin H. Clark tells me that the agouti has been introduced into the southeastern end of Bequia, where, however, it has not thriven, possibly for lack of sufficient water. It is not found on the other Grenadines. On St. Vincent it still occurs, among the wooded highlands; and Mr. Clark obtained a specimen here in 1904, and writes that, although largely nocturnal, it may sometimes be seen in the daytime tearing to pieces rotten stumps and fallen trees, apparently for the insect larvae inhabiting them. Farther north, it is well known to occur on Sta. Lucia, whence the Museum possesses specimens taken some thirty years ago by Mr. John Semper. Probably it once lived in most or all of the larger islands to the northward; for Du Tertre, in 1654, includes it as a well known species among the French isles. He mentions no particular island as its habitat; but since his title is a "Histoire Générale des Isles de S. Christophe, de la Guadelovpe, de la Martinique," etc., it may be assumed that it was found on them. The eruptions of Martinique may have contributed to exterminate it there. At all events I have not found it definitely recorded from that island. Labat, writing in 1742 (**3**, p. 23) of the Antilles, voices his belief that it is found in all the islands. He acknowledges that he did not find it on Martinique, for which perhaps the snakes may have been responsible, but he knew it to be common on Guadeloupe, Dominica, and St. Kitts. Chapman (1897, p. 29) records a specimen taken in Dominica. where it was said to be still common in the interior of the island, There is a specimen in the collection of the U. S. National Museum from the island of Montserrat, received in 1902. In the catalogue of the Museum of Comparative Zoölogy are recorded two skins of the agouti from St. Kitts (or St. Christopher) received in 1881 from F. Lagois, but they are not now to be found. A specimen from this island was lent to me, however, by the U. S. National Museum. The British Museum has specimens also from St. Thomas (Alston, P. Z. S., 1876, p. 348). The possibility of its having been introduced into these more northern islands is of course not to be overlooked, but there is no evidence of it. Du Tertre (1654) states that among the French Isles they are much hunted for their flesh, with dogs trained to run them. They usually seek shelter in a hollow tree, whence the hunters smoke them out. He says further that the female brings forth two young at a birth, in a nest made on the ground under a bush. The

Caribbean Indians used the sharp incisor teeth of the agouti in their ceremonies, for cutting the skin all over their bodies to draw the blood.

CASTOROIDIDAE.

Amblyrhiza inundata Cope.

Amblyrhiza inundata Cope, Proc. Amer. Phil. Soc., 1868, p. 313.

Loxomylus latidens et *quadrans* Cope, *Ibid.*, 1870, p. 608; 1871, p. 102.

In 1868 there was deposited at Philadelphia a cargo of cave earth, limestone fragments, and bone breccia, brought for commercial purposes from the island of Anguilla. A number of bone fragments were discovered by Cope in this shipment, and among them the remains of a large extinct rodent, which he named *Amblyrhiza inundata.* At the instance of Professor Cope, the colonial physician at St. Martin's made further investigation of the Anguilla caves and sent back a quantity of fragments, including the femur of an Iguana, portions of the leg bone of a rodent the size of an agouti, and perhaps related to it, a fragment of an artiodactyle, "apparently a member of the Bovidae," as well as more portions of Amblyrhiza, including teeth, on which Cope promptly founded two species of a new genus — *Loxomylus quadrans* and *L. latidens* — but these are now considered synonymous with *Amblyrhiza inundata.*

Very recently, J. W. Spencer (1910) has announced the discovery of Amblyrhiza remains in a cavern on the island of St. Martin's, and notes the further discovery in Cuba by Professor de la Torre, of "a large Pleistocene fauna of rodents, edentates and other vertebrates, as also excellent specimens of Jurassic fossils."

Note.— *Coendu pallidus* Waterhouse.— The prehensile-tailed porcupine is attributed to the "West Indies" by Waterhouse (Mammalia, 1848, **2**, p. 435), on the basis of a skin so labeled in the British Museum. Probably this specimen came from Trinidad.

OCTODONTIDAE.

CAPROMYS PILORIDES (Pallas).

Mus pilorides Pallas, Nov. Spec. Quad. Glir. Ord., 1778, p. 91.

Mr. F. M. Chapman in his revision of the genus notes specimens of this Cuban species from El Guama and San Diego de los Baños in western Cuba, and from Trinidad in central southern Cuba. The Museum of Comparative Zoölogy has specimens from Matanzas in northwestern Cuba, and one from Puerto Principe in east central Cuba. It appears to be commoner than *C. prehensilis*, and is known locally as 'Hutia congo.'

Although the teeth of this species are said to be similar to those of *C. prehensilis*, this is rather understating the case; for in *pilorides* the outer enamel folds are much deeper than in the long-tailed species, a point that has apparently not hitherto been emphasized.

Concerning *Capromys elegans*, described in 1901 by Latorre, there seems considerable likelihood that it is merely a partially albinistic and very brightly colored example of *C. pilorides*. It is based on a mounted skin in the Madrid Museum (labeled as from Cuba), and is briefly diagnosed as follows: "C. rufo-flavus, capite, cauda, pedibusque castaneo-fuscis, macula faciali minima, flava; macula alia dorsali magna, lanceata, fusca, albo-limbata; pilis frontalibus erectis." The tail is described as partly naked, due apparently to abrasion of the hairs. The general dimensions of the skin are nearer those of a small *C. pilorides*, rather than of *C. prehensilis* or even *melanurus*, to which latter it is said to approximate in the shape of the head! The measurements given are: head and body, 485; tail, 200; hind foot without claw, 75. Until further evidence is forthcoming, it appears better not to recognize this as a distinct species.

CAPROMYS PILORIDES RELICTUS, subsp. nov.

Type.— Adult male, skin and skull, No. 10,996, M. C. Z., from Casas Mountains, Nueva Gerona, Isle of Pines, Cuba; collected 10 March 1902, by Walter R. Zappey.

General characters.— Externally similar to *C. pilorides* of Cuba, but smaller. Skull and teeth markedly smaller and more lightly built throughout; postpalatal fossa differently shaped; premaxillaries extending back slightly beyond the nasals.

Description.— General color a grizzled yellowish brown, paler on the belly and tail, where the yellowish prevails. Short hairs about the muzzle whitish, shading into pale russet between the nose and eyes. Crown, nape, and entire dorsal surface and sides of body, and the throat, a coarsely grizzled pale ochraceous and black, or Prout's brown. The black is most prominent on the shoulders, and gives place to Prout's brown on the sides and throat. The separate hairs are hair-brown at the base, then black for one half or more of their length, with a subterminal ring of ochraceous, succeeded usually by a very small black tip. On the sides of the body the hair-brown is much more extensive, nearly to the exclusion of the black. Numerous entirely black hairs occur among the particolored hairs of the back. Upper surfaces of the forearms and feet nearly clear Prout's brown. Ears scantily clothed with short buffy hairs. Long hairs about the base of the tail nearly clear ochraceous buff, giving place to the shorter buffy hairs of the terminal three fourths. Ventral surfaces of the body and limbs nearly clear buffy, darkened by the hair-brown bases which everywhere show through. The vibrissae are numerous and long, the more dorsal ones black, the more ventral clear white.

A second specimen, also from the Casas Mountains of Nueva Gerona, is quite similar in coloration, except that the hairs lack the ochraceous tint, and are instead buff in their paler portions, producing thus a much grayer effect. Neither specimen shows the rufous tint that is so prominent in some specimens from Cuba, nor are there traces of incipient albinism, such as are usually found in Cuban examples. These characters, however, are subject to such variation in the typical race that it would be unsafe to assume that the Isle of Pines Capromys may not occasionally be rufescent or albinistic.

Skull.— The skull of *C. pilorides relictus* differs more widely, it would seem, from that of *C. pilorides pilorides,* than does that of *C. prehensilis gundlachi,* of the Isle of Pines, from the Cuban prototype. It is about one sixth smaller, and proportionately lighter, with smaller and more slender teeth. The form of the postpalatal fossa is remarkably different. In the Cuban *pilorides,* its anterior outline is that of a broadly rounded arch, reaching about to the level of the middle of the posterior molar. In *relictus* this fossa is at first narrow and parallel-sided, then becomes V-shaped, with the point at about the level of the anterior end of the last molar. In typical *pilorides,* the posterior border of the nasals reaches or exceeds that of the premaxillaries; whereas, in the two specimens of *relicta,* the nasals are slightly exceeded by the posterior prolongations of these bones. In all the skulls of the Cuban *pilorides* examined, the posterior dorsal border of the parietal has a conspicuous medial emargination; whereas that of *relictus* is nearly straight across. Apparently, also, the slight postorbital processes of the frontal seen in the Cuban skulls are much less developed in the Isle of Pines race; so that the supraorbital margin is much more nearly straight. Other slight differences, such as the greater curvature of the ventral outline of the ramus, are less tangible, or due, perhaps, to individual variation.

Measurements.— No external measurements of the Isle of Pines specimens were taken. The dry skins, which are carefully made, show the following dimensions in millimeters:—

No.	*Total length.*	*Tail.*	*Hind foot.*	*Ear.*
10,996 Type	773	238	92	25
10,997	690	230	89	25

The skull of the type lacks the condylar region. Its dimensions follow; and for comparison the corresponding measurements of a Cuban *C. pilorides*, No. 7231, are added in parentheses: — greatest length, 94.5 (111); palatal length, 42 (53); diastema, 25 (32); zygomatic breadth, 49 (52); interorbital constriction, 27 (29); nasals (median length), 25 (36.5); upper cheek teeth (alveoli), 20 (23); lower cheek teeth (alveoli), 20.5 (23); ramus from condyle to tip of incisors, 63.5 (76).

Capromys prehensilis Poeppig.

Capromys prehensilis Poeppig, Journ. Acad. Nat. Sci. Philadelphia, 1824, ser. 1, **4**, p. 11.

Poeppig considered this species to be rarer than *C. pilorides.* He had specimens from the mountains of southern Cuba— Partido de las Piedras, Macurizes, Masmariges. Mr. Chapman records specimens from western Cuba, at San Diego de los Baños and Cabañas. No doubt this and the short-tailed hutia were once generally distributed throughout the island. Its local names are "Hutia caraballi" or "Hutia mono."

Capromys prehensilis gundlachi Chapman.

Capromys prehensilis gundlachi Chapman, Bull. Amer. Mus. Nat. Hist., 1901, **14**, p. 317, pl. 39, 2 figs., text-fig. 2.

This race is confined to the Isle of Pines, where it represents *C. prehensilis.* The fact that both the common species of Capromys (*C. pilorides* and *C. prehensilis*) have representatives on the Isle of Pines, off the southwest coast of Cuba, is evidence of their former general distribution throughout at least the Cuban portion of Antillea. The fact of the differentiation of these Isle of Pines animals in numerous striking cranial characteristics further indicates a long period of isolation. Mr. Chapman's account of the variations exhibited by his series of six *gundlachi* and seven *prehensilis* may point to a less tendency to albinism in the Isle of Pines animals, as seemed also to be true of the new race of *pilorides* described above from that island.

Capromys melanurus Poey.

Capromys melanurus Poey, Monatsb. k. preuss. Akad. Wiss. Berlin, 1864, p. 384.

The type of this species came from Manzanillo in the southeast of Cuba, where it was locally called "Andaraz". Dobson (1884) in his account of its anatomy, states that his two specimens were from the mountains (Sierra Maestra) at the southern extremity of the island, eight miles north-northeast of Portillo. It is supposed to be at present confined to this eastern portion of Cuba, but no specimens seem to have been taken for many years. A comparison with skins of *prehensilis,* to which it seems closely related, is much to be desired. Dobson's figure, drawn from an alcoholic specimen, indicates a rather bushy-tailed animal. Mr. Chapman considers that *Capromys poeyi* of Guérin (1834) is a synonym of *C. prehensilis* Poeppig (1824), but it may well be that Guérin was describing the animal now known as *C. melanurus* of Poey (1864). Guérin specially notes the tail as entirely covered with long rusty hairs and lacking the naked space below. Poey also indicates a supposed smaller species, with yellow unringed hair, and in a footnote the name *C. pallidus* is applied to it by Peters (Monatsb. k. preuss. Akad. Wiss. Berlin, 1864, p. 384 and footnote).

Capromys (Geocapromys) thoracatus True.

Capromys thoracatus True, Proc. U. S. Nat. Mus., 1888, **11**, p. 469.

This was described from two specimens obtained on Little Swan Island, where the animal is said still to occur, and is called "Hutia". The discovery of the genus on this small island is of extraordinary interest as tending to confirm the theory of a former land connection from the peninsula of Honduras to Jamaica.

Capromys (Geocapromys) brownii Fischer.

Capromys brownii Fischer, Synopsis Mamm., Addenda, 1830, p. 389 (=589).

This dark-colored short-tailed Capromys is probably still to be found in the wooded parts of Jamaica. In addition to a mounted specimen, the Museum has a skin and skull collected in Jamaica in July, 1905, by Capt. Wirt Robinson.

Capromys (Geocapromys) ingrahami Allen.

Capromys ingrahami Allen, Bull. Amer. Mus. Nat. Hist., 1891, **3**, p. 329, fig. 1–10.

The discovery of this animal on one of the Plana Keys, situated between Acklin's and Maraguana Islands, of the Bahama group, was made only twenty years since. As noted by Allen (1891) it was common and easily obtained on this small islet of only four or five miles in length and about half a mile wide. No trace of Capromys was found on the neighboring islands; and there is no evidence that it has been on them within historic times. Columbus, in his journal, distinctly states that no wild quadrupeds were met with in the Bahama Islands among which he first landed (*viz.*, Watling's Island, Rum Cay, Long Island, and Exuma). Not until he reached Cuba did Columbus find the hutia. Catesby's reference to the Bahama Coney in his Natural History of Carolina, Florida and the Bahama Islands, (1743) throws no light on the subject. His figure seems to represent the common *C. pilorides* of Cuba. Of early references to these mammals, those of Oviedo have been very often quoted, but always with much uncertainty as to what animals were really meant. A valuable transcription, with commentary, has been given by MacLeay (1829), who was familiar with Capromys in Cuba. Gonzalo Hernandes de Oviedo y Valdes published in 1535 his "Historia general de las Indias," and a second edition appeared in 1547. Oviedo seems to have lived in the present island of San Domingo and Haiti, and his notes on mammals appertain to that island. He admits, however, that he had his information concerning them at second hand. He mentions the following four native species, as well as a kind of dog. The *Hutia* was of a gray mixed color, somewhat less than a rabbit, with rat-like ears and tail. It was considered excellent food, and already was becoming scarce but fifty years after the discovery by Columbus. This animal is supposed to have been one of the long-tailed Capromys. Possibly it was Plagiodontia, described and figured nearly three hundred years later by F. Cuvier, though MacLeay thought it might be similar to the Cuban *C. prehensilis.* The *Quemi* was likewise found in San Domingo; but Oviedo considered it even then extinct. According to many persons who had seen it, it was as large as a small hound or beagle, gray like the hutia, and of the same form and proportions. MacLeay considers this some form of Capromys related to the Cuban *C. pilorides.* A third form, called *Cori,* appears to have had a very short tail; and is unhesitatingly referred to the Guinea-pig by MacLeay. It is more likely, however, that this was one of the short-tailed Capromys, standing thus midway between that of Jamaica and that of the Plana Keys, Bahamas. The fourth animal is the *Mohuy,* the size of a hutia, but clearer gray, and with stiffer hair. Possibly this may have been the Plagiodontia, although at this late date, it seems impossible to determine its identity with any assurance.

CAPROMYS COLUMBIANUS Chapman.

Capromys columbianus Chapman, Bull. Amer. Mus. Nat. Hist., 1892, **4**, p 314, text-figs. 3, 4.

The fragment on which this species is based was found in a subfossil condition in a cave near Trinidad, Cuba. Imbedded in the walls of the cave were found molluscan shells said to be identical with those of existing species, a fact that indicates a recent age for this animal. The portion of the skull discovered shows a palate so strongly contracted at its anterior end that the alveoli of opposite sides are brought nearly into contact. So striking is this difference in the width of the palate that it seems doubtful if the animal described should be considered congeneric with Capromys.

PLAGIODONTIA AEDIUM F. Cuvier.

Plagiodontia aedium F. Cuvier, Ann. Sci. Nat., Zool., 1836, ser. 2, **6**, p. 347, pl. 17.

Of this interesting animal, nothing further seems to have been discovered since it was first described nearly seventy-five years ago, from San Domingo.

LONCHERES ARMATUS (I. Geoffroy).

Nelomys armatus I. Geoffrey, Ann. Sci. Nat., Zool., 1838, ser. 2, **10**, p. 125.

The occurrence of a spiny rat in the island of Martinique seems first to have been made known by Dr. F. W. True, who, in 1885, published a note on a specimen procured there by F. A. Ober, and received in 1878, with other collections, by the U. S. National Museum. Apparently no direct comparisons with other species were made; but from the published descriptions, Dr. True was "inclined to believe that the specimen should be classed with *L. armatus*." Dr. True at that time believed the species to have been recently introduced into the island, and considered it not unlikely that many small rodents were from time to time brought over by sailing vessels from the South American continent to these islands.

On the other hand, Mr. Austin H. Clark, who collected for some weeks on Martinique in 1904, states that the natives of the island assured him that a spiny rat was to be found there, though he obtained none. This bit of evidence may indicate that the species is really indigenous, and still survives in this one of the Lesser Antillean Islands.

MURIDAE.

ORYZOMYS ANTILLARUM Thomas.

Oryzomys antillarum Thomas, Ann. Mag. Nat. Hist., 1898, ser. 7, **1**, p. 177.

This Jamaican species is based on a single specimen in the British Museum, collected by P. H. Gosse some time prior to 1850. Two skins in the collection of the U. S. National Museum are also noted by Thomas as mentioned by Coues (Coues and Allen, Monographs of North American Rodentia, 1877, p. 116, footnote). These two were collected about 1877, five years after the introduction of the mongoose. Since this date no specimens seem to have been taken, and it is perhaps nearly, if not quite, extinct. No trace of this genus has ever been found on the other Greater Antilles, although Dobson (Proc. Zool. Soc. London, 1884, p. 234, footnote) gives "*Hesperomys palustris*" as a species of Cuba, or of Jamaica, or both, believing it to have been introduced from the United States. Probably this reference really applies to the native Jamaican rice-field mouse. Undoubtedly, the introduction of the Old World rats and mice must have contributed in great measure to reduce the numbers of any indigenous species in these islands, and the addition of the mongoose would seem to leave little hope of their escape from utter annihilation.

According to Thomas, the Jamaican Oryzomys is closely related to *Oryzomys couesi* of Central America, whose range extends northward to Honduras, Guatemala, and Chiapas in southern Mexico.

ORYZOMYS VICTUS Thomas.

Oryzomys victus Thomas, Ann. Mag. Nat. Hist., 1898, ser. 7, **1**, p. 178.

St. Vincent is the only island of the Lesser Antilles from which this genus is now known. The single specimen on which the species is based was collected for the British Museum about 1892, by H. H. Smith, who marked it "forest rat." Its relationship is evidently with South American rather than Central American species, and it is compared with the continental *O. longicaudatus.* It is probably approaching extinction, if it is not already extinct. A thorough search on the other Lesser Antilles might reveal the presence of the genus; but Chapman, in several days' trapping in Dominica, failed to find it, nor did we get it in the Grenada forests. The introduced rats, which are everywhere common on the islands, would hardly fail to drive it out, wherever the two come into competition.

MEGALOMYS DESMARESTII (Fischer).

Mus desmarestii Fischer, Synopsis Mammalium, 1829, p. 316.

The so called "Muskrat of the Antilles" probably once occurred throughout all or most of the Windward Islands. De Rochefort, in 1658, includes it as one of the five native mammals of Tobago. On Santa Lucia it was also found, and on Martinique. Du Tertre, however, writing in 1654, mentions it from Martinique only, of the French islands. Here they were commonly eaten by the people, who, after singeing the hair, exposed them to the air over night, and then boiled them, throwing off the first water in order to get rid of the strong musky odor. In the Paris Museum are said to be six specimens of this genus, including the type of the present species, collected by D.

Plée in Martinique. Major (1901) notes that a specimen from the same place, collected also by Plée, is in the Leyden Museum. No recent examples appear to have been collected, and it is not unlikely that it has been entirely exterminated by the rats and human enemies.

MEGALOMYS LUCIAE (Major).

Oryzomys luciae Major, Ann. Mag. Nat. Hist., 1901, ser. 7, **7**, p. 206.

The Santa Lucia muskrat has been recently described as a peculiar island form. It differs conspicuously from that of Martinique in having the belly wholly brown instead of white. The type is a specimen in the British Museum, taken some sixty years ago.

MEGALOMYS "MAJORI" Trouessart.

Megalomys majori Trouessart, Catalogus Mammalium, fasc. 2, Rodentia, 1904, p. 415 (*nomen nudum*).

In his description of the Santa Lucia muskrat, Forsyth Major (1901, p. 206) briefly refers to a fragment of this rat, consisting of the lower teeth, found in a fossil state in a small ossiferous breccia in the island of Barbuda. This he considers to represent an extinct species but does not discuss it further. Trouessart, in the last issue of his 'Catalogus Mammalium,' proposes the name *majori* for this animal, but gives no description, and erroneously quotes the locality as Barbados. The name is therefore a nomen nudum, and the characters of the supposed species are still unknown.

MUS MUSCULUS Linné.

Mus musculus Linné, Syst. Nat., ed. 10, 1758, **1**, p. 62.

The house mouse, although generally distributed among the Antilles, appears to be less abundant than the rats. Chapman did not obtain it among the mammals trapped on Dominica. Du Tertre (writing in 1654) notes its introduction into the French islands, but says that it was not very common, and it apparently increased far less rapidly than the black rat. The Museum has specimens from Grenada, St. Kitts, and Haiti. Feilden (1890) testifies to its abundance on Barbados, and notices that the specimens taken there seem redder than usual.

Epimys rattus (Linné).

Mus rattus Linné, Syst. Nat., ed. 10, 1758, 1, p. 61.

Epimys rattus alexandrinus (Geoffroy).

Mus alexandrinus Geoffroy, Descript. de l'Egypte, Mamm., 1818, p. 733.

These rats were very early introduced into the West India islands, and have become generally distributed among them. Apparently they increased enormously at first, and became a serious menace to the growing of certain crops, as the sugar cane. It was with the hope of exterminating them that the mongoose was first brought to Jamaica. Already, in 1654, Du Tertre makes mention of the great abundance and voracity of the rats among the French islands. He says that they destroy all sorts of fruits and green plants, especially sugar-cane. Hughes (1750) says that in Barbados they "are so very numerous, and so very destructive to Sugar-canes, that the yearly Loss to the Inhabitants of the Parishes of *St. Joseph's* and *St. Andrew's* alone, is computed to be no less than Two or Three Thousand Pounds."

At the present time, although still abundant on the islands, they appear, on some at least, to have reached a sort of adjustment as one of the faunal elements, and are not so noticeably destructive. This, at all events, appears to be the case in Grenada, where they are everywhere found, even in the primeval forest about Grand Etang, in the interior of the island. No reports of damage from rats were brought to notice, and no signs of destruction to the cocoa or fruits were seen. It may well be that the mongoose serves to check their increase, though it can hardly exterminate them. In Grenada we once started a rat from a heap of dried leaves in a cocoa orchard, It at once ran up a tree, and passing from limb to limb, quickly evaded our pursuit.

A few specimens of *M. alexandrinus* were taken in San Domingo by A. H. Verrill in 1906. In Cuba, Gundlach (1866–7, p. 55) thought it less common than the black rat, and speaks of its making round nests in trees. Browne, in his History of Jamaica (1789, p. 484) speaks of the "cane rat" as so destructive in the sugar fields that it often destroys one fourth or more of the crop. He adds, "There are great numbers of them in every plantation, though they take great pains to get rid of them; for the watchmen have seldom anything else to do but set traps for them, which they do with infinite art and ease. Numbers of the negroes roast these animals in the stoke-holes, and eat them; and I have been informed by men of character, who have tasted of them, that they are very delicate meat."

EPIMYS NORVEGICUS (Erxleben).

Mus norvegicus Erxleben, Syst. Regni Anim., 1777, **1**, p. 381.

The brown rat seems to be less common in some at least of the islands than the black and the roof rats. Chapman (1897, p. 30) records the capture of two specimens in Dominica.

Gundlach (1866–7, p. 55) a half century ago considered this more abundant and destructive than the black or the roof rat in Cuba. He writes that it lives more in holes in the ground; and not only kills the domestic fowls, but gnaws the sugar canes to such an extent as to effect serious damage.

Fielden (1890) says this is an abundant species in Barbados, where he had found no other.

VIVERRIDAE.

MUNGOS BIRMANICUS (Thomas).

Herpestes auropunctatus birmanicus Thomas, Ann. Mag. Nat. Hist., 1886, ser. 5, **17**, p. 84.

In 1872, W. Bancroft Espeut imported four pairs of mongoose from Calcutta to Jamaica, for the purpose of destroying the rats that caused so great a destruction of sugar-cane. These four pairs increased so rapidly, and attacked the rats with such ardor, that ten years later it was estimated that they effected an annual saving to the colony of 100,000 pounds sterling. Shortly after, however, they had so reduced the rats that they fell upon the native ground animals, and nearly annihilated certain toads, lizards, birds, and mammals. Even young pigs, lambs, kittens, and newly dropped calves were said to have been killed by them; and their diet included also various fruits and even sugar-cane. In consequence of the destruction of the toads and lizards, it is said (Howard, Science, new ser., 1897, **6**, p. 384), the ticks became so abundant and so infested the mongoose that its numbers soon lessened greatly. Duerden, however (Journ.

Jamaica Inst., 1897, **2**, p. 471), doubts the supposed destruction by ticks, and probably with reason. The diminution was more likely due to other causes, by which a gradual adjustment of the newly added faunal element was taking place.

Three specimens of mongoose, taken on the island of Grenada in 1910, are all in worn pelage. One appears to be in process of molting, and has shed the long hairs along the middorsal line of the rump and base of the tail. A comparison of these specimens with a series of Indian *M. griseus,* to which the mongooses of the West Indies have hitherto been tacitly referred, shows at once that they are smaller, and differently colored. On further study, they prove to be unquestionably *M. birmanicus* of eastern India (Burmah, Assam), and exactly agree in external appearance with a skin of that species from "East India" in the collection of the Museum. The long hairs of the back are usually five-banded; the basal ring is dark, the succeeding one whitish, the next black, then one of buff-yellow, with finally a black tip. These hairs cover the entire dorsal surfaces, giving a general yellowish brown grizzled appearance. Ventrally, the hairs are without the black tips, and the buff-yellow ring is so prominent as to impart its color to the throat, anal region, and ventral part of the base and sides of the tail proximally. The tarsus is naked along a line that narrows to the heel. The skull is decidedly smaller than that of *M. griseus.* The external measurements of two adults from Grenada are as follows, the first dimension in each case being that of a male, the second that of a female: total length, 666 mm., 561; tail, 265, 255; hind-foot, 60, 60; ear from meatus, 21, 23. The skulls of the same individuals measure respectively: greatest length, 68, 64; basal length, 65, 60; palatal length, 38, 35; zygomatic breadth, 35, 32; postorbital constriction, 11, 11; length of upper cheek teeth, anterior base of canine to back of molar ^{2}, 25.5, 24; length of premolar ^{4} from posterior end to tip of inner lobe, 8, 7; transverse width of upper molar ^{2}, 3.6, 3.5; lower cheek teeth, 28.8, 27.5; lower mandible from condyle to tip of incisors, 41, 42.6.

In addition to the specimens from Grenada, the Museum has a skin and skull of the same species taken in April, 1909, by Dr. Thomas Barbour at Port Antonio, Jamaica. Browne, in his History of Jamaica, speaks of what seem to have been at least two species of mongoose that had been brought captive to Jamaica from Africa, but these were apparently never loosed.

In the seventies, mongooses were brought from Jamaica to Grenada, as I am told by Mr. Septimus Wells of that island, who remembers seeing the first crate of them brought to St. George's. On Grenada they are now common, not only about the houses and plantations, but even in the forests on the hill-tops of the interior. Mr. John Branch tells me that they seem now to be less common than they were a few years ago, so that on his estate at Point Saline, at the south end of the island, the ground lizards (Ameiva) that were nearly exterminated by the mongoose are now reappearing in small numbers. Possibly some sort of adjustment is going on, so that the mongoose is finding its place as part of the fauna in relation to the other animals. Nevertheless in Grenada the mongoose has evidently much reduced the ground lizards, but the damage done to the native birds is less evident. Apparently the mountain ground dove (Geotrygon) has suffered somewhat; and of the pea dove (*Engyptila wellsi*) I could find no trace during my stay in 1910. The agouti also seems to be nearly extinct in Grenada, due, it is supposed, to the killing of the young by this rapacious beast. Neither Mr. Clark nor I learned of the mongoose being in the Grenadines.

Mr. Austin H. Clark, who has kindly supplied some notes made by him during a stay in the Windward Islands in 1903, says that the mongoose is abundant on Barbados and St. Vincent, and is present also on Sta. Lucia. It is not uncommon to see as many as six in a morning's walk on Barbados or St. Vincent.

On Barbados it is a great menace to the raising of domestic fowls, turkeys, and ducks; for the young birds fall an easy prey. The decrease in the number of feral hares is attributed to the destruction of their young by this animal, as is also the diminution of the ground dove. According to Feilden (1890), the mongoose was introduced in Barbados a few years prior to 1890, to stop the damage done by rats. It seems effectively to have decreased these pests, so that it was uncommon to see much harm to the cane fields.

On St. Vincent, the mountain ground dove (Geotrygon) has disappeared, and the common ground dove (Columbigallina) and the ani (Crotophaga) have been reduced in numbers, supposedly by the ravages of this animal. Because of the destruction of the ground lizards on St. Vincent, the mole crickets are said to have increased to such an extent as to be a pest to the agriculturist.

Among the Greater Antilles, the mongoose is now in Jamaica, Cuba, San Domingo, and Porto Rico. From San Domingo I have examined a skin with part of the skull, taken April 26, 1895, at San Domingo City, and kindly loaned me for examination by the Field Museum of Natural History. This is the specimen previously recorded by Dr.

Elliot as the large Indian mongoose (*Mungos mungo*); but its skull and external measurements are identical with those of *M. birmanicus*, although the coloration is a somewhat lighter gray. I have little hesitation in considering it an unusually pallid specimen of the latter species.

The only Porto Rican specimen I have seen is one taken in 1899 by A. B. Baker, and now in the collection of the U. S. National Museum. This specimen had rightly been identified as *M. birmanicus*. According to Palmer (1899, p. 95) the mongoose was introduced at San Juan, Porto Rico, about 1877–79, and is now generally distributed in that island. It is said to have acted very effectively in reducing the number of rats there. Palmer further states that the mongoose is present in the small island of Vieques, just east of Porto Rico, and is abundant on St. Thomas. "Numbers" had also been sent to Cuba and St. Croix. Apparently they have not yet spread throughout Cuba, but are now common in certain parts of the western end of the island. Mr. Walter R. Zappey tells me that when he visited Cuba in 1906 the mongoose was so common about the Toledo plantation, near Havana, that it was nearly impossible to raise poultry.

It has been suggested that more than one species may have been introduced into the West Indies, but all that I have seen are the Burmese mongoose. It is common now in at least four of the southern Lesser Antilles, and in the seven islands above named, in the northern part of the West Indian group.

PROCYONIDAE.

Procyon maynardi Bangs.

Procyon maynardi Bangs, Proc. Biol. Soc. Washington, 1898, **12**, p. 92.

This raccoon, so far as known, is confined to the island of New Providence, Bahamas. In his list of mammals of the Bahamas, Mr. G. S. Miller Jr. (1905) has given excellent illustrations of the skull of this small species. According to its describer, no tradition of its having been introduced from elsewhere was discovered; but Miller notes that J. H. Riley, who collected at New Providence in 1903, heard unsatisfactory reports of its having long ago been brought thither.

PROCYON MINOR Miller.

Procyon minor Miller, Proc. Biol. Soc. Washington, 1911, **24**, p. 4.

This newly described raccoon is known from a single young male which was received by the U. S. National Museum from the l'Herminier Museum. It was collected at Pointe-à-Pitre, Guadeloupe Island. It seems to be a small, or dwarfed, species somewhat resembling the Bahama raccoon.

It can be at present a matter of conjecture only whether or not this animal reached Guadeloupe by natural means. Possibly it was introduced by the French in the early days.

PROCYON ? CANCRIVORUS (G. Cuvier).

For many years a raccoon has existed on the island of Barbados, but there is no record of specimens being compared with the mainland forms. Hughes, writing in 1750, speaks of a bounty being offered for their destruction; and Schomburgk, in 1848, considered them at that time 'scarce.' Feilden (1890) believed this animal to be *P. cancrivorus*, and stated that it was still to be found in considerable numbers in the rocky parts of the island. He thought its presence probably accidental, and indeed it is not impossible that it may have been introduced by man, or even have found its way on floating tree-trunks to the windward shores of the island.

SOLENODONTIDAE.

SOLENODON PARADOXUS Brandt.

Solenodon paradoxus Brandt, Mém. Acad. Imp. Sci. St. Pétersbourg, 1833, ser. 6, **2**, p. 459, pls. 1, 2.

Since the publication of my paper on this species in 1910, additional specimens have been received from San Domingo by the American Museum of Natural History and the United States National Museum. These were part of a shipment of five living animals sent to the zoölogical gardens at New York and Washington.

SOLENODON CUBANUS Peters.

Solenodon cubanus Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, (1861), 1862, p. 169.

Practically nothing has been added to our knowledge of this species since the account published by Peters in 1861, and the subsequent description of its anatomy by Dobson.

Gundlach records it from the Sierra Maestra and Bayamo (south-eastern Cuba), and the country between Cienfuegos and Trinidad (south-central Cuba).

Poey (1851) goes at some length into the accounts of the early historians of Cuba to show that this animal, which he names the 'Almiqui' was unknown to the discoverers. Gundlach (1866–7, p. 44) believes, however, that Pichardo ('Diccionario de voces Cubanos') is probably correct in identifying the *Ayre* of Oviedo with the Solenodon.

EMBALLONURIDAE.

PEROPTERYX CANINA PHAEA, subsp. nov.

Type.— Adult female, skin and skull, No. 8101, M. C. Z.; collected at Point Saline, Grenada, 29 Aug. 1910, by G. M. Allen.

General characters.— Intermediate in external dimensions between *P. trinitatis* and *P. canina*; skull as large as in the latter; fur in the brown phase lacks the reddish cast seen in *canina*.

Description.— The type resembles specimens of *P. canina* in its general appearance, except that the fur above and below is nearly unicolor, of a dark Prout's brown, quite without the reddish cast characteristic of the continental species. The color difference is practically the same as that between *P. kappleri* and the brighter *P. canina.* The fur is long and light with an erect bang on the forehead. The membranes are blackish.

Measurements.— The dimensions of the type in the flesh are: length, 63 mm.; tail, 17; foot, 8.5; ear, 14; tibia, 18; forearm, 42. The skull measures: greatest length, 14.3; basal length, 10.5; palatal length, 4; interorbital constriction, 2.5; zygomatic breadth, 8; mastoid breadth, 7.1; mandible, 9; maxillary tooth row (exclusive of incisors), 5.4; mandibular tooth row (exclusive of incisors), 5.9.

Remarks.— The Peropteryx from Grenada is very closely related to those of Trinidad and the mainland adjacent. Mr. G. S. Miller Jr.

(Bull. Amer. Mus. Nat. Hist., 1899, **12**, p. 178) has characterized the former as *P. trinitatis*, a smaller animal than *P. canina*, with a forearm averaging 40 mm. (39–41) instead of 45, as in *P. canina*. Robinson and Lyon give forearm measurements of *P. canina* from La Guaira, Venezuela, ranging from 41 to 45 mm.; average of eleven specimens, 42. These Venezuela specimens are therefore rather smaller than typical specimens from eastern Brazil, the forearm of which is given by Gervais as 45 mm. The sixteen adults obtained by us in Grenada show extremes of 41–44.5 mm. in forearm measurements, with an average of 42.5. They are therefore to be distinguished from those of northern South America by the color alone, a character which is, however, rather striking. From the Peropteryx of Trinidad they are differentiated by the forearm measurement, but the color of this species is unknown except from alcoholic specimens. Although the Grenada Peropteryx differs but slightly from its nearest representatives to the south, it seems nevertheless advisable to emphasize these differences by giving a subspecific name, since a somewhat similar trend of variation is found in the races of *Artibeus planirostris* inhabiting the same areas.

An interesting point, apparently not yet recorded for the continental Peropteryx, is the occurrence of a dark color phase in the Grenada race. Thus among the adults taken, are a few colored entirely of a sooty brown, somewhat darker than Ridgway's clove-brown.

We found these bats in but one spot, a rather open cave on the sea-cliffs at Point Saline, the extreme southern end of the island. They clung by both hind feet to the rough surfaces of the rock, usually in well-shaded, overhanging places; but, on being disturbed, would flit farther into the darker recesses of the cave. Others, however, flew about under a tree near the mouth of the cave, but eventually took shelter in adjoining fissures. Their characteristic sprawling position when they first alight, with forearms spread out holding the body against the wall, is noted by Robinson and Lyon. When alarmed, they make a sharp, twittering noise, not very loud.

NOCTILIONIDAE.

Noctilio leporinus (Linné).

Vespertilio leporinus Linné, Syst. Nat., ed. 10, 1758, **1**, p. 32.

Vespertilio mastivus Dahl, Skrift. Naturhist. Selsk. Kjöbenhavn, 1797, **4**, pt. 1, p. 132, pl. 7.

The fish-eating bat seems to be generally distributed among the Antilles. Indeed, its habit of feeding on small fish would naturally lead it over the water, so that its occurrence on most of the islands would not be remarkable. Dobson records specimens from Jamaica (Mt. Edgecombe), St. Thomas, and Grenada; Tomes mentions one example from Long Hill, Jamaica; Elliot has noted it from Mona and Dr. J. A. Allen (1890) from Antigua. Dahl in 1797, described it from St. Croix as *V. mastivus*, but the status of this supposed form is still in doubt. Gundlach (1866–7, p. 51) considers it a rare species in Cuba, where it is sometimes seen flying about over the lagoons. He says it is also found in Guadeloupe. The Museum has specimens from Grenada, Sta. Lucia, and St. Vincent, the last collected by Mr. Austin H. Clark in 1903. Mr. Clark tells me that this bat usually resorts by day, to deep narrow clefts in the rocks, rather than to more open caves, and that its presence in such places may often be detected by its peculiar musky odor.

P. H. Gosse (1847) has given an account of the habits of this bat in Jamaica, where he found a colony spending the daytime in the interior of a large hollow tree.

PHYLLOSTOMIDAE.

CHILONYCTERIS MACLEAYII Gray.

Chilonycteris macleayii Gray, Ann. Nat. Hist., 1839, **4**, p. 5.

Mr. Rehn, in his review of this genus (1904), notes that this bat seems to be found throughout Cuba. It rests hanging in clusters in caves, and often frequents houses as well.

In a series of over fifty Cuban skins, collected by Mr. W. Palmer, Mr. Miller has noted a very interesting dimorphism. Apparently a larger and a smaller form occur together, independent of age or sex.

CHILONYCTERIS MACLEAYII FULIGINOSA Gray.

Chilonycteris fuliginosa Gray, Proc. Zool. Soc. London, 1843, p. 20.

This subspecies is confined to the island of San Domingo, and, according to Rehn, is the smallest of the genus.

CHILONYCTERIS MACLEAYII INFLATA Rehn.

Chilonycteris macleayii inflata Rehn, Proc. Acad. Nat. Sci. Philadelphia, 1904, p. 190.

On the island of Porto Rico, to which this species is confined, "the phyla represented by *M. fuliginosa* and *M. inflata* reaches its extreme type in the latter race, the most apparent diagnostic character of which is the inflated rostrum." There is apparently no appreciable difference in size.

CHILONYCTERIS MACLEAYII GRISEA Gosse.

Chilonycteris grisea Gosse, Naturalist's Sojourn in Jamaica, 1851, p. 326, pl. 6, fig. 1.

In addition to its larger size, the Jamaican representative of the *macleayii* group differs so markedly in other slight peculiarities that, according to Rehn, no general comparison with the other races is needed. He notes specimens from Phoenix Park (the type locality), Oxford Cave, Kingston, and Lucea.

CHILONYCTERIS PARNELLII (Gray).

Phyllodia parnellii Gray, Proc. Zool. Soc. London, 1843, p. 50.

According to Rehn, the only definite records for this Jamaican bat are: — Sportsman's Hall, Oxford Cave, and Lucea. Osburn (1865, p. 68) gives an account of its habits in captivity.

CHILONYCTERIS PARNELLII BOOTHI Gundlach.

Chilonycteris boothi Gundlach, Monatsb. k. preuss. Akad. Wiss. Berlin, 1861, p. 154.

This is the Cuban representative of the Jamaican *C. parnellii* but differs "in the disposition of the lower premolars, the more depressed rostrum, and the more robust form" (Rehn, 1904, p. 197).

The lower second premolar is not so crowded as in *parnellii*, and is visible from either labial or lingual aspect of the jaw.

Miller (1904) records specimens obtained from a cave near Baracoa, Cuba.

CHILONYCTERIS PARNELLII PORTORICENSIS Miller.

Chilonycteris portoricensis Miller, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 400.

The Porto Rico Chilonycteris differs from that of Cuba, chiefly in its smaller ears. As shown by Miller, the second lower premolar is separated from the first and the third by a distinct space, whereas in the Jamaican species the first and third lower premolars are in contact, and the second is forced quite out of the tooth row. The type locality is near Pueblo Viejo, Bayamon district, Porto Rico.

Pteronotus davyi Gray.

Pteronotus davyi Gray, Mag. Zool. Bot., 1838, **2**, p. 500.

So far as present knowledge goes, this species, though common in Brazil, Venezuela, and Trinidad, is unknown in the West Indies except in the island of Dominica, whence it has been recorded by several writers (Thomas, Ann. Mag. Nat. Hist., 1892, ser. 6, **10**, p. 410; Miller, Proc. Biol. Soc. Washington, 1902, **15**, p. 155; Rehn, Proc. Acad. Nat. Sci. Phila., 1904, p. 254). There is also a specimen in the Museum of Comparative Zoölogy from Dominica, taken in 1906, by Mr. A. H. Verrill.

Mormoops blainvillii Leach.

Mormoops blainvillii Leach, Trans. Linn. Soc. London, 1820, **13**, p. 77, pl. 7.

The type locality of this bat is Jamaica, to which it seems confined. Mr. Rehn (1902a), in his review of the genus, mentions specimens from Moneague, St. Ann, and Kingston. Tomes (1861, p. 65) records it from Freeman's Hall and Sportsman's Cave.

On the continent, this genus is represented throughout Mexico and Central America by a single, somewhat larger, and quite different species (*M. megalophylla*). If the insular races are to be derived from continental stock by way of Yucatan and Central America, it is evident that much differentiation has taken place since the continuity of the land areas. On the island Curaçao, off the coast of northern South America, is a form so slightly differentiated from *M. megalophylla* that it is considered by Rehn to be merely a subspecies. The Antillean representatives, however, more nearly resemble each other than they do their continental relatives, indicating perhaps that these islands have been connected at a period later than their separation from the mainland.

Mormoops blainvillii cinnamomea (Gundlach).

L[*obostoma*] *cinnamomeum* Gundlach, Arch. f. Naturg., 1840, **6**, pt. 1, p. 357.

The relationships of this bat are evidently with the Jamaican Mormoops, of which Rehn considers it a subspecies. Miller, however, (1904, p. 343) "can see no necessity . . . .for applying to this well marked form a trinomial name"; but I have here followed Rehn in order to emphasize this relationship. The chief point of distinction is that the first upper premolar of *cinnamomea* attains its greatest thickness posteriorly, giving the tooth a subconoid, instead of a rhomboid, outline. The type locality is Casetal St. Antonio el Fundador, Cuba; but specimens apparently indistinguishable are recorded by Rehn from San Domingo (Aquacate), and Mona Island, between San Domingo and Porto Rico.

OTOPTERUS WATERHOUSII (Gray).

Macrotus waterhousii Gray, Proc. Zool. Soc. London, 1843, p. 21.

The typical subspecies is confined to the island of San Domingo and Haiti. The type was from the latter country; and additional specimens are recorded from San Domingo City by Elliot (1896, p. 82) and from Caña Honda by J. A. Allen (1908a, p. 581).

OTOPTERUS WATERHOUSII JAMAICENSIS (Rehn).

Macrotus waterhousii jamaicensis Rehn, Proc. Acad. Nat. Sci. Philadelphia, 1904, p. 433.

The Jamaican Otopterus has been separated from those of the neighboring islands on the basis of smaller size combined with slight cranial differences. It is said to be one of the commonest of the bats on the island. Specimens are recorded from Spanishtown and Kingston; the Museum contains two specimens from Port Antonio, collected in 1909 by Dr. Thomas Barbour.

OTOPTERUS WATERHOUSII MINOR (Gundlach).

Macrotus minor Gundlach, Monatsb. k. preuss. Akad. Wiss. Berlin, 1864, p. 382.

This Cuban representative of *waterhousii* is said to be readily characterized by its small size and deeper coloration, though it closely approaches the Jamaican race. The type came from western Cuba.

Rehn (1904a) in his revision of the genus, has likewise referred to the Cuban subspecies three specimens in the National Museum collection from the mountainside near Nueva Gerona, Isle of Pines. Miller (1904) records specimens taken in Cuba by William Palmer at Guanajay and El Cobre, in the first instance from a cave, in the second from a copper mine. The predilection of this bat for underground caverns is well known. Gundlach believed that those in the eastern part of Cuba were larger than those from the western portion of the island.

OTOPTERUS WATERHOUSII COMPRESSUS (Rehn).

Macrotus waterhousii compressus Rehn, Proc. Acad. Nat. Sci. Philadelphia, 1904, p. 434.

The form of Otopterus occurring in the Bahama Islands has been recognized as a subspecies on the ground of its narrow rostrum and elongate-elliptical first lower premolar. The type specimen is from Eleuthera Island, whence the National Museum possesses six examples as well as one from Long Island, to the south. Mr. Rehn has also examined a specimen from Andros Island, which is probably one of three recorded by Dr. J. A. Allen (1890, p. 170) as taken there by Dr. J. I. Northrop. At Nassau, New Providence, a considerable colony inhabited the dungeon of old Fort Charlotte, but hitherto the species has not been noted from the northern islands of the group (Abacos and Great Bahama).

LONCHORHINA AURITA Tomes.

Lonchorhina aurita Tomes, Proc. Zool. Soc. London, 1863, p. 83.

The specimen on which Tomes based this species was found by him in a jar containing several species of West Indian bats, including *Mormoops blainvillii* and *Pteronotus davyi*, but unfortunately without indication of locality. Seventeen years later a second example was reported from 'New Grenada,' in the collection of the British Museum (Dobson, Rept. Brit. Assoc., 1880, p. 196; p. 28 of separate). A third specimen was recently found by Mr. G. S. Miller, Jr., in the collection of the Academy of Natural Sciences of Philadelphia (No. 1770). This is an adult male, and was captured in Nassau Harbor, New Providence, Bahamas (Miller, 1905, p. 382), and thus confirms, in part, the supposed West Indian habitat of the species. No further specimens are known.

VAMPYRUS SPECTRUM (Linné).

Vespertilio spectrum Linné, Syst. Nat., ed. 10, 1758, **1**, p. 31.

Dobson (1878, p. 471) records a skin and skull of this large species from Jamaica. They were obtained there by J. S. Redman, and are preserved in the British Museum. I am not aware of other records.

This bat, like Sturnira and Hemiderma, probably reached Jamaica by a former land connection with Honduras, but did not range far enough to the north to reach Cuba by way of Yucatan.

GLOSSOPHAGA LONGIROSTRIS Miller.

Glossophaga longirostris Miller, Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 330.

At St. George's, Grenada, we obtained eight specimens of both sexes, from holes, in the old fort on Richmond Hill. One of these was immature, though nearly full grown; the rest were adults. Five more adults were taken at Grand Etang (1800 feet), Grenada. These five were found hanging to the ridge pole in a room of a disused stable, whence they obtained egress by means of a partially opened window. These bats were extremely alert throughout the day, and on the slightest alarm would dart through the window and flit off into the forest close by. It was only through great caution in approaching the window and closing it quickly that we were able to capture them, after several unsuccessful attempts.

The specimens represent both the dark (nearly Broccoli brown) and the brighter (Mars brown to russet) phases, irrespective of sex.

The type of this species, which is in the collection of the Museum of Comparative Zoölogy, is from the Santa Marta Mountains, Colombia, where also a large series was obtained for the American Museum of Natural History, from Bonda and Taguaga, in "a cave on the seashore" (J. A. Allen, Bull. Amer. Mus. Nat. Hist., 1900, **13**, p. 89). Lieutenant Wirt Robinson likewise found it abundant at La Guaira, Macuto, San Julian, and Pena de Mora, all in Venezuela. Our specimens extend its known range into the Lesser Antilles; and the Museum also possesses a large series from Carriacou, among the Grenadines, collected a few years ago by Mr. Austin H. Clark.

The occurrence of *G. soricina* on Trinidad has been recorded by Allen and Chapman (1897, p. 15) and by Rehn (1902, p. 38); but I have found no reference to its occurrence in the Windward Islands other than that of Dobson (1878, p. 501), who notes specimens in the British Museum from Grenada and "? Isle of St. Vincent." As this was before *longirostris* was discriminated, it seems likely that these references are to that species. On the Venezuelan coast, Robinson found *longirostris* the commoner of the two species of Glossophaga, in the proportion of 12 to 1.

In the type specimen of *G. longirostris,* the lower incisors are entirely wanting, although their alveoli are distinctly visible. Among a series of thirty-four specimens, also from the Santa Marta Mountains, Colombia, in the collection of the American Museum of Natural History, "the incisors are all present in both jaws" in nearly one half of the individuals; "in about one-third of the series they are entirely absent in both jaws; in the remainder some of the incisors are present and the alveoli of those lacking are clearly indicated. Apparently they are absent, as a rule, only in old specimens" (J. A. Allen, Bull. Amer. Mus. Nat. Hist., 1900, **13**, p. 90). All the incisors are present in our series of eleven adults from Grenada, but only five of the thirteen specimens from Carriacou have the entire number. Of the eight in which the number of incisors is incomplete, three have lost one or other of the first lower incisors; one has lost the lower right and the upper left incisors; one, the lower right first and second, and left upper second incisors; one has lost all the lower incisors but the second on the left side; and one has lost the left upper second incisor only. As might be expected, therefore, it is the first lower incisor that is commonly the first to go. As originally suggested by Mr. G. S. Miller Jr., this species is doubtless in process of losing the lower incisors, and is thus approaching the condition found in the related genera, Lichonycteris, Choeronycteris, and Hylonycteris, which have quite lost these teeth.

Glossophaga soricina antillarum Rehn.

Glossophaga soricina antillarum Rehn, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 37.

The type and two other specimens of this subspecies came from Port Antonio, Jamaica, where they were collected in December, 1890. In a letter to the writer, Mr. Rehn suggests that this race is perhaps nearer to *longirostris* than to *soricina*; but on geographical grounds this seems doubtful although no careful comparison of the two has yet been made. The forearm measurement is given as 38 mm.; extreme length of skull, 22.5, as against 35 and 20 or 21 for the corresponding measurements of *soricina*. A skull collected in the Bahamas and referred to this same subspecies, is stated to be in the collection of the Academy of Natural Sciences of Philadelphia.

MONOPHYLLUS REDMANI Leach.

Monophyllus redmani Leach, Trans. Linn. Soc. London, 1822, **13**, p. 76.

This species, so far as known, is confined to Jamaica. The genus is of peculiar interest in that it is apparently confined to the West Indies, with island races in both Greater and Lesser Antilles.

MONOPHYLLUS CUBANUS Miller.

Monophyllus cubanus Miller, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 410.

Gundlach (1866–7, p. 48) records this bat from Cuba under the name *Monophyllus redmani*. He had found it in but two caves, one at Rangel, in the western part of the island, and a second at Guisa, in the eastern extremity. This Cuban representative is later described by Miller as nearest the Jamaican *M. redmani*, but slightly smaller, with a more slender skull. "In the general form of both skull and teeth it is, however, more closely related to the large Jamaican species than to the smaller members of the genus." The type and a number of other specimens came from a cave at Baracoa, Cuba.

MONOPHYLLUS PORTORICENSIS Miller.

Monophyllus portoricensis Miller, Proc. Washington Acad. Sci., 1900, **2**, p. 34.

The Porto Rico Monophyllus is the smallest of the four species hitherto made known. The type and five other specimens were collected in a cave at Bayamon, Porto Rico.

MONOPHYLLUS CLINEDAPHUS Miller.

Monophyllus clinedaphus Miller, Proc. Washington Acad. Sci., 1900, **2**, p. 36.

In view of the fact that, so far as known, no member of this genus has been taken on the mainland of America, it is probable that this species, described from a single specimen without locality, is likewise Antillean. In size and other characters it approaches nearest to *M. redmani* of Jamaica. Possibly its home may be looked for in San Domingo.

MONOPHYLLUS LUCIAE Miller.

Monophyllus luciae Miller, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 411.

The Santa Lucia Monophyllus is, as might be expected, "nearly related to that of Barbados. Its larger size and less crowded teeth readily distinguish it."

MONOPHYLLUS PLETHODON Miller.

Monophyllus plethodon Miller, Proc. Washington Acad. Sci., 1900, **2**, p. 35.

The type was collected in St. Michael's Parish, Barbados. It is a strongly characterized species, and, strangely enough, appears to have escaped observation in this thickly populated island until 1899.

HEMIDERMA PERSPICILLATUM (Linné).

Vespertilio perspicillatus Linné, Syst. Nat., ed. 10, 1758, **1**, p. 31.

Dobson's (1878, p. 494) statement that this bat occurs "throughout the West Indian islands" is probably based on the fact that he had specimens from the eastern and western extremes of the group,— namely, one each from Grenada and Jamaica. These constitute the only specific records I have found for it in the West Indies. The species is common on the tropical mainland of South and Central America north to southern Mexico. It occurs in Trinidad, whence it may have reached Grenada at times when a connection existed. Its presence in Jamaica may equally be explained by assuming a former connection with the Honduras peninsula. Its case is somewhat paralleled by that of *Sturnira lilium,* whose range on the mainland probably did not extend sufficiently far to the north to enable it to reach Cuba by a Yucatan connection.

No critical comparison appears to have been made between specimens from Jamaica and the mainland.

STURNIRA LILIUM (E. Geoffroy).

Phyllostoma lilium E. Geoffroy, Ann. Mus. Hist. Nat. Paris, 1810, **15**, p. 181.

The occurrence of this bat in Jamaica is of considerable interest. I have found but two records, namely, those given by Dobson (1878, p. 540) of two skins in the British Museum obtained in Jamaica by P. H. Gosse and J. Gould. On the mainland, this bat is common in northern South America, and in Central America as far north as Honduras and the southernmost states of Mexico. It may therefore have reached Jamaica when there was still a land connection with the Honduras peninsula. In Yucatan it is apparently almost unknown. There is said to be a specimen in the British Museum from northern Yucatan; but otherwise Colima, in southwestern Mexico, seems to be its most northerly record (J. A. Allen, Bull. Amer. Mus. Nat. Hist., 1890, **3**, p. 181). It is probably so rare to the north of latitude 20° that it did not reach Cuba by way of the Yucatan connection, thus accounting for its apparent absence on the other Greater Antilles.

I have found no record of this bat for the Lesser Antilles, and it is therefore of special interest to note its discovery in the island of Dominica by A. H. Verrill. The specimens referred to were among a small collection of bats, now in the Yale University Museum, made by Mr. Verrill in Dominica in 1906. In addition to the present species, there were a number of *Pteronotus davyi*, which is well known to occur in this island. Through the kindness of Professor A. E. Verrill, I was enabled to study the collection, and to obtain one of the specimens of Sturnira for the Museum of Comparative Zoölogy. The presence of this genus in Dominica is in line with the known occurrence in the same island of representatives of the South American *Pteronotus davyi* and *Myotis nigricans*, both of which are present in Trinidad, but have not yet been recorded from the intermediate islands.

BRACHYPHYLLA CAVERNARUM Gray.

Brachyphylla cavernarum Gray, Proc. Zool. Soc. London, 1834, p. 123.

This genus is at present known from two species only, *cavernarum*, of St. Vincent, and *nana*, of Cuba. The exact significance of this distribution it is perhaps unsafe to conjecture until further research shall have shown more convincingly that the genus does not occur on the other Antillean islands. According to Miller it is the least specialized of the stenodermatous bats. Hence, it may once have been more widespread, and the colonies now existing in Cuba and St. Vincent may represent the last remnant of a disappearing race.

In St. Vincent this bat was apparently to be found in only one large cave near Barrouallie. Mr. Austin H. Clark, who visited this place in 1903, writes that it is a rather large chamber with two entrances, one at about the high-water mark, and rather low; the other about ten feet in height, through which a boat may be rowed. He saw but two bats, both of which were secured, and proved to be of this species. A few years before, a collector who visited the spot, obtained a large number; and the bats appear subsequently to have left.

In his list of mammals of Barbados, Col. Feilden (1890) has included this species, which, he says, is locally known as the "Night Raven"; and adds that the British Museum has specimens of the genus from Cuba, St. Vincent, and other parts of the West Indies. If this identification be correct, it is of very great interest; and it is to be hoped that the other localities may be verified and published.

BRACHYPHYLLA NANA Miller.

Brachyphylla nana Miller, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 409.

So far as known, this bat is confined to the island of Cuba, whence it was described in 1902, from a single skull found at El Guama in the pellet of a Cuban barn owl. It is a smaller animal than the *B. cavernarum.* In a subsequent paper Mr. Miller (1902c, p. 249) has given external measurements and a description of the skin, on the basis of specimens from the southern part of Santiago province.

Dobson, in his Catalogue of the Chiroptera of the British Museum, had recorded this genus from Cuba, but considered the species the same as that of St. Vincent, as did also Gundlach. The latter author (1866–7, p. 50) found it abundant in caves at San Cristobal, and mentions occasional specimens from the vicinity of Matanzas and Cárdenas, Cuba.

ARTIBEUS JAMAICENSIS Leach.

Artibeus jamaicensis Leach, Trans. Linn. Soc. London, 1821, **13**, p. 75. Jamaica.

Madataeus lewisii Leach, Trans. Linn. Soc. London, 1821, **13**, p. 81. Jamaica.

Artibeus carpolegus Gosse, Naturalist's Sojourn in Jamaica, 1851, p. 271, pl. 6, fig. 5. Jamaica.

Dermanura eva Cope, Amer. Nat., 1889, **23**, p. 130. St. Martin's.

Artibeus coryi Allen, Bull. Amer. Mus. Nat. Hist., 1890, **3**, p. 173. St. Andrew's.

Artibeus insularis Allen, Bull. Amer. Mus. Nat. Hist., 1904, **20**, p. 231. St. Kitt's.

Dr. Knud Andersen (1908), in the preparation of his recent monograph of this genus, has examined a very large series of this species from various points in Central America and the West Indies, and is unable to find recognizable differences between those from the mainland and those from many of the Antillean Islands. Specimens indistinguishable from typical *jamaicensis* are found in Panama, Nicaragua, Guatemala, Campeche, and southern Mexico. In the synonymy of this race, Andersen puts several nominal species described from the different islands. He has examined specimens from St. Andrew's, Old Providence Island, Jamaica, San Domingo, Porto Rico, St. Martin's, St. Kitt's. To this race should also probably be referred the specimens recorded by Dr. J. A. Allen (1890, p. 170) from the small islands Anegada, Virgin Gorda, Anguilla, and Antigua; and, according to Andersen, those from San Domingo referred to *A. j. parvipes* by the same writer (Allen, 1908, p. 581). It is interesting that no specimens are known from the Bahamas, where the genus seems absent.

ARTIBEUS JAMAICENSIS PARVIPES Rehn.

Artibeus parvipes Rehn, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 639.

This is the Cuban representative of *A. jamaicensis*, and the smallest of the group. It is, however, only very slightly smaller than the Jamaican bat. Its supposed occurrence at Key West rests on no satisfactory basis, and should be disregarded until better evidence is forthcoming. According to the studies of Dr. Knud Andersen, the Cuban bat is rather more similar in cranial characters to *A. j. yucatanicus* of the neighboring peninsula of Yucatan than to typical *A. j. jamaicensis*, although externally all three are similar. This fact, however, is considered to indicate that *parvipes* reached Cuba by way of the land tongue now represented by the Yucatan peninsula, a conclusion no doubt well justified.

Palmer found this a common species in eastern Cuba, and obtained it in the Isle of Pines as well.

Mr. Miller (1902, p. 410) has recorded the finding of remains of this species in the pellets of the Cuban barn owl, which shows that it is occasionally captured by that bird.

ARTIBEUS JAMAICENSIS PALMARUM Allen and Chapman.

Artibeus palmarum Allen and Chapman, Bull. Amer. Mus. Nat. Hist., 1897, **9**, p. 16.

This race, described from the island of Trinidad, is recorded by Andersen (1908, p. 279) from St. Vincent only, of the West Indies. Its occurrence should be expected probably on the intermediate islands, and on Tobago as indicated by this author.

ARTIBEUS JAMAICENSIS PRAECEPS Andersen.

Artibeus jamaicensis praeceps Andersen, Ann. Mag. Nat. Hist., 1906, ser. 7, **18**, p. 421.

Andersen has named this race on the basis of three specimens from Dominica and Guadeloupe. The type is from the latter island, and represents a form a very little smaller than *A. j. palmarum*, of which it is considered a northern offshoot. Its similarity to *A. j. aequatorialis* of Ecuador and southern Colombia is so great that the two are indistinguishable, a fact which Andersen believes is due to parallelism in development.

ARTIBEUS PLANIROSTRIS GRENADENSIS Andersen.

Artibeus planirostris grenadensis Andersen, Ann. Mag. Nat. Hist., 1906, ser. 7, **18**, p. 420.

A series of forty specimens was obtained in 1910 at St. George's, Grenada, from the recesses of an old fort on Richmond Hill. Here was evidently a breeding colony; and as usual among bats of this genus, the adults were mainly of one sex, for, of the thirty adults, all but four were females. The breeding season was apparently over, for all but one of the young obtained were well grown. The single exception was still suckling, and of about half the bulk of its mother.

Dr. Knud Andersen (1908, p. 204–319) has shown that the bats of the *planirostris* group have spread from the mainland of South America to the southernmost of the Lesser Antilles, and in Trinidad and Tobago have become slightly differentiated (*A. p. trinitatis*), as well as in Grenada (*A. p. grenadensis*).

ARDOPS HAITIENSIS Allen.

Ardops haitiensis J. A. Allen, Bull. Amer. Mus. Nat. Hist., 1908, **24**, p. 581.

A single specimen from Caña Honda, San Domingo, is the type of this newly discovered species. The three other known members of the genus are Lesser Antillean.

The closely allied genera, Phyllops and Ariteus, seem to represent Ardops on the islands of Cuba and Jamaica respectively. The case seems nearly paralleled by that of the Phyllonycterine bats, represented in Jamaica by Reithronycteris, in Cuba by Phyllonycteris,— each monotypic,— and in other of the Greater Antillean islands (Bahamas, Porto Rico) by Erophylla. In this instance, however, there is also a Cuban species of Erophylla.

ARDOPS MONTSERRATENSIS (Thomas).

Stenoderma montserratense Thomas, Proc. Zool. Soc. London, 1894, p. 133.

In the island of Montserrat is found this large species, where, according to its describer, it is said to do considerable damage among the cocoa plantations (probably in eating the young fruit). During the day it is found hanging under the branches of trees. The forearm measurement is given in the type as 51.5 mm.

ARDOPS NICHOLLSI (Thomas).

Stenoderma nichollsi Thomas, Ann. Mag. Nat. Hist., 1891, ser. 6, **7**, p. 529.

This bat is known from Dominica only, to which it is supposed to be peculiar. Its forearm measurement is 46 mm.

ARDOPS LUCIAE (Miller).

Stenoderma luciae Miller, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 407.

The Santa Lucia Ardops differs from that of Dominica (*A. nichollsi*), according to Miller, in its larger size and more deeply bifid inner upper incisor. It is smaller than *A. montserratensis,* and with a distinct white shoulder spot.

PHYLLOPS FALCATUS (Gray).

Arctibeus falcatus Gray, Ann. Nat. Hist., 1839, **4**, p. 1.

Stenoderma albomaculatum Gundlach, Monatsb. k. preuss. Akad. Wiss. Berlin, 1867, p. 155.

This genus is closely related to Ardops of the Lesser Antilles and Haiti. The single known species is confined to Cuba, where it appears to be very rare. According to Gundlach, it has been noted at Matanzas and Cárdenas, and occasionally enters houses.

ARITEUS ACHRADOPHILUS (Gosse).

Artibeus achradophilus Gosse, Naturalist's Sojourn in Jamaica, 1851, p. 271, pl. 6, fig. 4.

Ariteus flavescens Gray, Mag. Zool. Bot., 1837, **2**, p. 491.

The type species is the only form of this genus known. It is apparently confined to Jamaica, although Dobson (1878, p. 528) recorded a specimen from Cuba, but probably in error for Phyllops, as Miller (1907) does not credit it. It appears to be nearly akin to Ardops, but lacks the last molar, while the first lower molar retains the metaconid. It seems probable, therefore, that it represents Ardops in Jamaica, as Phyllops represents it in Cuba.

The related genus Stenoderma, known from a single specimen without locality, may eventually be rediscovered in the West Indies.

NOTE.— *Centurio senex* Gray.— A specimen supposed to have come from Cuba, was mentioned by Lichtenstein and Peters in 1854, but Peters later wrote that this locality was erroneous (Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 1864, p. 382).

PHYLLONYCTERIS POEYI Gundlach.

Phyllonycteris poeyi Gundlach, Monatsb. k. preuss. Akad. Wiss. Berlin, 1860, p. 817.

This bat is certainly known from Cuba only, where it is locally abundant. Miller (1904, p. 344) has recently redescribed and figured this species on the basis of a magnificent series collected by Palmer at Guanajay, El Guama, and Baracoa, Cuba. Great numbers were taken in a large cave at the first-named locality. Gundlach records it from San Cristobal and Matanzas. The absence of calcar, and the reduced condition of the interfemoral membrane and of the molar cusps have led to the separation of the species from the bats formerly classed with it, as the representative of a monotypic genus confined to Cuba.

Miller (1902, p. 410) notes that the Cuban barn owl occasionally preys on this bat, as shown by the presence of skulls in owl pellets; and Palmer (Miller, 1904, p. 345) was assured by the natives that the Cuban boa at times captures them as they emerge in numbers from their cave.

REITHRONYCTERIS APHYLLA Miller.

Reithronycteris aphylla Miller, Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 334.

This remarkable species is still known from the type specimen only, an adult male taken in Jamaica and preserved in the museum of the Institute of Jamaica. The muzzle terminates in a "disc-shaped rudimentary nose leaf like that of *Brachyphylla cavernarum.*" The teeth are said to resemble closely those of *Phyllonycteris poeyi* of Cuba, now considered the sole member of its genus; this species has likewise a rudimentary nose leaf, "the erect portion represented by a mere bluntly angular projection" (Miller, 1907, p. 173). The close relationship of the three genera Phyllonycteris, Reithronycteris, and Erophylla is evident; and they are united by Miller in a distinct subfamily, Phyllonycterinae, confined, so far as known, to the Greater Antilles.

EROPHYLLA SEZEKORNI (Gundlach).

Phyllonycteris sezekorni Gundlach, Monatsb. k. preuss. Akad. Wiss. Berlin, (1860) 1861, p. 818.

So far as known, this species seems confined to Cuba, whence it was described by Gundlach. Peters, however, included Jamaica in its range (Monatsb. k. preuss. Akad. Wiss. Berlin, 1868, p. 364).

EROPHYLLA SANTA-CRISTOBALENSIS (Elliot).

Phyllonycteris santa-cristobalensis Elliot, Proc. Biol. Soc. Washington, 1905, **18**, p. 236.

The bat of this genus occurring in San Domingo has been recently separated on the basis of material from San Cristobal. Probably the relationships of this and the other described forms would be best expressed by a trinomial designation.

EROPHYLLA BOMBIFRONS (Miller).

Phyllonycteris bombifrons Miller, Proc. Biol. Soc. Washington, 1899, **13**, p. 36.

This island species is confined so far as known to Porto Rico. The type and thirteen other specimens were taken in a limestone cave near Bayamon, Province of San Juan.

EROPHYLLA PLANIFRONS (Miller).

Phyllonycteris planifrons Miller, Proc. Biol. Soc. Washington, 1899, **13**, p. 34.

This is a common species among the Bahamas. It was first described from specimens collected in the limestone caves at Nassau, New Providence. On Great Abaco it was found abundantly in the sea caves at Hurricane Hole, in 1904; and a few were found at Marsh Harbor (G. M. Allen, 1905, p. 70). Miller (1905, p. 382) further records it from New Providence, Eleuthera, and Long Island, where it was collected by J. H. Riley.

NATALIDAE.

NATALUS STRAMINEUS Gray.

Natalus stramineus Gray, Mag. Zool. Bot., 1838, **2**, p. 496.

No type locality is assigned to this species, but it is probably the mainland of South America. Miller (1902, p. 399) records a series of eighteen specimens from Dominica, and contrasts these with the race found in San Domingo. Its occurrence in some of the intermediate islands is to be expected.

NATALUS STRAMINEUS MAJOR Miller.

Natalus major Miller, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 399.

This bat was described from a specimen taken near Savaneta, San Domingo. It is slightly larger than specimens from Dominica, and is by Elliot considered a subspecies of *N. stramineus*.

CHILONATALUS BREVIMANUS (Miller).

Natalus (*Chilonatalus*) *brevimanus* Miller, Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 328.

The slight differences in measurements of this Old Providence Island bat have led to its separation from the Jamaican species *C. micropus,* to which it is closely related. It was first recorded from the island in 1890 by Dr. J. A. Allen, and Mr. G. S. Miller (1898) has since tabulated the measurements of twenty specimens from the same place.

In characterizing the subgenus Chilonatalus, Miller states that "the form of the glandular elevation above the nostrils and the apparently double lower lip, taken in connection with the other characters pointed out by Harrison Allen in which the *Natalinae* resemble *Chilonycteris* and *Mormoops,* may indicate a closer relationship between the two groups than has heretofore been suspected."

CHILONATALUS MICROPUS (Dobson).

Natalus micropus Dobson, Proc. Zool. Soc. London, 1880, p. 443.

Dobson founded this species on Jamaican specimens, obtained near Kingston. Miller (1904) records a specimen collected at Baracoa, Cuba, by W. Palmer, which he was unable to distinguish from the Jamaican animal. The measurements given (forearm, 32) seem very slightly smaller than those of the latter (forearm 32, 34, 34), but at present there appears to be no reason for separating the Cuban from the Jamaican bat.

CHILONATALUS TUMIDIFRONS Miller.

Chilonatalus tumidifrons Miller, Proc. Biol. Soc. Washington, 1893, **16**, p. 119.

Among the Bahamas occurs a Chilonatalus closely allied to *C. micropus* and *C. brevimanus.* The type and three other specimens were collected in 1903 at Watling's Island. The following year a large colony was found on Great Abaco, some two hundred miles to the northwest, in a limestone cave (G. M. Allen, 1905, p. 68).

NYCTIELLUS LEPIDUS (Gervais).

Vespertilio lepidus Gervais, in La Sagra's Hist. Fis. Pol. y Nat. de la Isla de Cuba, 1838, part 2, **3**, p. 32.

Miller (1904, 1907) has pointed out the characters separating this as the type and only known species of a genus distinct from Natalus, though closely allied. He states that it is externally the least specialized member of the Natalidae, though "in the peculiar form of the skull, and in the reduced size of the anterior canine and premolar it represents a more advanced stage than any of the related genera."

It was originally recorded from Cuba, and was obtained in 1900 by W. Palmer in the Isle of Pines, at Nueva Gerona. Its flight is said to be very low, about bushes, and close to buildings. Gundlach (1866–7, p. 52) speaks of it as common in certain parts of the island of Cuba, as at Matanzas, Guines, and Cabo Cruz.

Tomes (1861) referred to this species certain Jamaican specimens which seem later to have been described by Dobson as *Natalus micropus*.

VESPERTILIONIDAE.

MYOTIS DOMINICENSIS Miller.

Myotis dominicensis Miller, Proc. Biol. Soc. Washington, 1902, **15**, p. 243.

This Myotis, recently described from the island of Dominica, is nearest related to *M. nigricans* of South America, from which it differs in its slightly smaller size, and in having the face-line of the skull more abruptly elevated above the level of the rostrum. Its presence in Dominica raises the presumption that the genus will eventually be found on some at least of the islands to the south as well.

Elliot (Field Columb. Mus. Publ., Zool. Ser., 1904, **4**, p. 580) includes "West Indies" in the range of *Myotis lucifugus*, but on what grounds is not evident, for the genus seems to be as yet unknown from any other of the Antilles.

EPTESICUS FUSCUS CUBENSIS (Gray).

Scotophilus cubensis Gray, Ann. Nat. Hist., 1839, **4**, p. 7.

In his report on Cuban bats collected by W. Palmer, Mr. Miller

(1904) states that in color the Cuban brown bat is practically identical with the large Mexican *miradorensis,* to which he considers it most closely related. Specimens of *E. f. osceola,* from southern Florida, also approach it very closely in the rich dark brown of the fur.

Eptesicus fuscus bahamensis (Miller).

Vespertilio fuscus bahamensis Miller, N. Amer. Fauna, 1897, no. 13, p. 101, fig. 26, b.

The differences between the brown bat of the Bahamas and its larger relative of the mainland were pointed out in 1890 by Dr. J. A. Allen, but were not recognized by name until seven years later. In color it seems practically indistinguishable from typical *E. fuscus,* but in measurements it is nearly as small as *propinquus* of Central America. The possibility of this bat being a derivative of *propinquus,* and having reached the Bahamas from Central America by way of a Jamaica–San Domingo connection has been previously suggested. I can find no records for this species except from New Providence, Bahamas, where it haunts the dungeon of old Fort Charlotte.

Nycticeius humeralis cubanus (Gundlach).

Vesperus cubanus Gundlach, Monatsb. k. preuss. Akad. Wiss. Berlin, 1861, p. 150.

The Cuban Nycticeius has been shown by Miller (1904, p. 338) to be merely a small insular race of the species inhabiting the south-eastern United States. As in the case of Eptesicus, it has no known representatives in the other Greater Antilles or the Windward Islands. Gundlach records it from Havana and Cárdenas.

Lasiurus [vel Nycteris] pfeifferi (Gundlach).

Atalapha pfeifferi Gundlach, Monatsb. k. preuss. Akad. Wiss. Berlin, 1861, p. 152.

The Cuban red bat is apparently an uncommon species, as indeed Gundlach remarks. It was not obtained by Palmer in 1900 and 1902. In color it is said to be brighter than *borealis* of the continent, and slightly larger, which suggests that its relationships may be with Central American rather than with southern Florida stock.

Gundlach (see Peters, 1862, p. 153) notes a female with three embryos at the beginning of May, and states that he obtained specimens at Cárdenas and in the Cienega de Zapata.

The applicability of the generic name Nycteris in place of Lasiurus seems not fully established.

LASIURUS [vel NYCTERIS] BOREALIS ? SEMINOLUS (Rhoads).

Atalapha borealis seminola Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1895, p. 32.

In a previous paper (1905, p. 67) I referred to this race, not without some hesitation, a single specimen of a red bat, taken at Nassau, New Providence, Bahamas. A second careful comparison with the red bat of southern Florida fails to disclose any very striking differences. The Bahaman specimen is apparently fully grown, but not quite adult; and though its measurements otherwise agree very well, that of the tibia seems slightly less than in Florida specimens. The color is less reddish underneath, but this may be due in part to other causes. Miller (N. Amer. Fauna, 1897, no. 13, p. 110) records a skull only, from Nassau. These two specimens indicate that the red bat is of regular occurrence at least in New Providence. The possibility of its introduction by vessels is perhaps not wholly out of the question. On the other hand, further specimens may show that the slight differences pointed out are constant, and sufficient to characterize a Bahaman race. Its affinities seem to be nearer *seminolus* than to *pfeifferi.*

Miller (1897) has also recorded a skin of the red bat from Spanishtown, Jamaica, but it was in such condition as to be unidentifiable with certainty. It suffices however, to establish the occurrence of the genus in Jamaica.

MOLOSSIDAE.

NYCTINOMUS BRASILIENSIS MUSCULUS Gundlach.

Nyctinomus musculus Gundlach, Monatsb. k. preuss. Akad. Wiss. Berlin, 1861, p. 149.

The type locality of the common Nyctinomus of the *brasiliensis* group, occurring in the Greater Antilles, is Cuba, whence it was described by Gundlach. Mr. G. S. Miller (1902b, p. 248) has pointed out that it is "readily distinguishable from all of the known continental members of the *Nyctinomus brasiliensis* group by its smaller size, shorter ear, and rudimentary, peg-like anterior upper premolar."

To this race I have referred a specimen in the Museum collection from Jeremie, Haiti; and in his recent paper on bats from San Domingo, Dr. J. A. Allen (1908, p. 581) has similarly identified three specimens from that island. Three others, collected in Jamaica by Dr. Thomas Barbour, and by him presented to the Museum of Comparative Zoölogy, seem, after careful comparison, to be essentially identical; and Mr. Miller has included Porto Rico, as well, in its range.

NYCTINOMUS BRASILIENSIS BAHAMENSIS Rehn.

Nyctinomus bahamensis Rehn, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 641.

This is a slightly larger and more grayish representative of the Cuban *N. b. musculus.* The type locality is Governor's Harbor, Eleuthera, Bahamas. Other specimens are recorded by the describer from Little Abaco, where, as well as on Great Abaco, it was found by the writer in 1904. Miller (1905, p. 380) also mentions it from Long Island, Bahamas, on the basis of specimens collected by J. H. Riley for the U. S. National Museum.

NYCTINOMUS BRASILIENSIS ANTILLULARUM Miller.

Nyctinomus antillularum Miller, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 398.

This is a slightly smaller form of the Nyctinomus of Cuba and Porto Rico, with a forearm of from 36.5 to 38.5 mm. It probably occurs throughout the Lesser Antilles. Miller records specimens from Tobago, St. Lucia, Dominica, Montserrat, and St. Kitts.

In the collection of the Museum of Comparative Zoölogy are three specimens from St. Kitts, and three from St. Bartholomew's Island, which appear to be referable to this species. The type locality is Roseau, Dominica. There can be little doubt that the relationship of this bat is best expressed by the use of a trinomial.

NYCTINOMUS MACROTIS Gray.

Nyctinomus macrotis Gray, Ann. Nat. Hist., 1839, **4**, p. 5.

This bat falls in the group of American Nyctinomi characterized by the presence of 2–2 lower incisors, and the slender, nearly parallel upper incisors. It was originally described from a specimen sent to W. S. MacLeay from the interior of Cuba, where it was found in a hollow tree. Palmer and Riley failed to obtain it, however, in the course of their recent work in that island. It is represented in Jamaica as well as in Cuba, and specimens from the two islands are considered identical. The skull of a Jamaican example is figured by Miller (1907, p. 253, fig. 43). Dobson (Report Brit. Assoc. Adv. Sci., 1880, p. 195) also notes specimens from Jamaica in the Kingston Museum.

Mormopterus minutus (Miller).

Nyctinomus minutus Miller, Bull. Amer. Mus. Nat. Hist., 1899, **12**, p. 173.

The discovery of this bat at Trinidad, Cuba, where it was collected in 1892 by Mr. Frank M. Chapman, is of very great interest. The genus is elsewhere known in America from Central Peru only, where it is represented by a slightly larger species, *M. kalinowskii* Thomas. In South Africa, Madagascar, and Mauritius, occur several forms; and one, *M. whitleyi* Scharff, has recently been described from West Africa (Benin). According to Mr. G. S. Miller, Jr., the two American species agree in having but 2–2 instead of 3–3 lower incisors.

Eumops glaucinus (Wagner).

Dysopes glaucinus Wagner, Arch. f. Naturg., 1843, pt. 1, p. 368.

Molossus ferox Gundlach, Monatsb. k. preuss. Akad. Wiss. Berlin, 1861, p. 149 (not of Tschudi).

Promops glaucinus Miller, Proc. U. S. Nat. Mus., 1904, **27**, p. 339.

Although, as shown by Miller (1904, p. 339), this bat was described from Cuba fifty years ago, it seems not to have been again noted until 1900, when a specimen was collected for the National Museum at Pina del Rio, Cuba, by W. Palmer and J. H. Riley. Mr. Miller was unable to distinguish the single example from the continental form; and, as shown by the measurements, the two are certainly almost identical.

Eumops orthotis (H. Allen).

Molossus glaucinus Dobson, Proc. Zool. Soc. London, 1876, p. 714.

Nyctinomus orthotis H. Allen, Proc. Amer. Phil. Soc., 1889, **26**, p. 561.

Nyctinomus orthotis H. Allen, Proc. U. S. Nat. Mus., 1890, **12**, p. 638.

Nyctinomops orthotis Miller, Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 393 (by *lapsus*).

Promops orthotis Miller, Proc. Biol. Soc. Washington, 1902, **15**, p. 250.

Eumops orthotis Miller, Bull. 57, U. S. Nat. Mus., 1907, p. 258.

This is the Jamaican representative of *Eumops glaucinus* of Central America and Cuba, with which, indeed, it was considered by Dobson identical. It is apparently a trifle smaller, but no careful comparison of the two forms has yet been published. The above synonymy is sufficient to show the vicissitudes of nomenclature through which this species has passed to its final place in the genus Eumops.

MOLOSSUS OBSCURUS VERRILLI Allen.

Molossus obscurus Auct.

Molossus fuliginosus Gray, Mag. Zool. Bot., 1838, **2**, p. 501, (not of Cooper, 1837).

Molossus fuliginosus Gray, Dobson, Cat. Chiropt. Brit. Mus., 1878, p. 413.

Mollossus [sic] *verrilli* Allen, Bull. Amer. Mus. Nat. Hist., 1908, **24**, p. 581.

Under the name *Molossus obscurus* are still currently confused at least two species, whose ranges and habits appear to be much alike. These are a smaller, glossy black animal, which, in a previous paper (1908, p. 59) I have shown to be *M. crassicaudatus*, with forearm measuring usually 36 or 37 mm.; second, a larger, browner bat, the true *M. obscurus*, with forearm 40 to 43 mm. The extremes of these two species may often approach each other very closely in many of their external measurements; but the bulk of the larger bat is very conspicuously, probably nearly a third, greater. The skulls are markedly different in size, that of *M. crassicaudatus* measuring in extreme median length 16 or 17 mm., that of *M. obscurus* from northeastern Brazil, 19 mm., with a more prominent, knife-like sagittal crest. The color differences between the two species are not so readily apparent in alcoholic specimens, a fact which has no doubt largely aided in their confusion, although in *M. obscurus* the more extensive pale bases to the hairs, especially of the shoulders and chest, will usually aid in distinguishing it. A further point of difference between the two species, and one that has not apparently been noticed hitherto, is that in *obscurus* there are on the posterior border of the femora, more particularly at the distal ends, some half dozen long hairs that project stiffly out nearly a centimeter beyond the short close fur. These hairs, though present in *crassicaudatus,* are much shorter, and less stiff, so that when wet in alcohol they lie flat with the fur of the body instead of projecting boldly.

Various authors have recorded *Molossus obscurus* from the West Indies; but in the absence of specimens on which these records are based, it is difficult to determine which of the two species is meant. This difficulty is increased by the fact that the West Indian representative of *M. obscurus* is slightly but constantly smaller than typical specimens from the mainland (the type locality is probably Surinam or Cayenne). This fact I pointed out previously (1908, p. 58), but at that time had only four specimens from the Lesser Antilles. Since then Dr. Thomas Barbour has presented to the Museum five alcoholic Molossi from Jamaica, collected by him at Mandeville in 1909. A comparison of these nine Antillean bats with a series of *M. obscurus* in the Museum collection from northeastern Brazil shows that the latter are larger and heavier-bodied, with larger skulls, teeth, and forearms. The specimens from Jamaica seem identical in every way with alcoholics from Dominica and Sta. Lucia. If this slight amount of difference be considered a sufficient basis for separating the Antillean Dusky Bat, the name *Molossus fuliginosus* of Gray, 1838, shown by Dobson (1878, p. 413) to be based on Jamaican specimens, would be available for it, except that this name is unfortunately preoccupied by *Molossus fuliginosus* of Cooper, 1837, for *Nyctinomus cynocephalus* of South Carolina. Recently, however, Dr. J. A. Allen has described as *Molossus verrilli* a skin and skull from Samana, San Domingo, which he compares with the much smaller *M. tropidorhynchus* of Cuba, than which it is said to be much larger and "general coloration darker." The measurements given are: forearm, 40 mm.; third metacarpal, 41; skull, total length, 17; width of brain case, 9.

The measurements of a specimen of Molossus (M. C. Z., No. 7382) from Mandeville, Jamaica, are given below, and in parentheses after each the corresponding dimensions of *M. obscurus* from Brazil (M. C. Z., No. 3063): — total length, 94 mm. (104 mm.); tail, 36 (40); hind foot, 8 (9); ear from meatus, 10 (15); tibia, 12 (14); forearm, 38.5 (43). Skull, greatest length, 17 (19); basal length, 12.4 (15); palatal length, 5.7 (7); zygomatic breadth, 10.8 (11.2); interorbital constriction, 4 (4); upper tooth row, excluding incisors, 6.4 (6.7); lower tooth row, excluding incisors, 7 (7.5). The actual difference indicated by these measurements does not seem great, and still less is this the case when they are compared with those of *M. crassicaudatus*. They are, however, sufficient to produce a difference in the relative bulk that is very striking to the eye; so that where the two species (*obscurus* and *crassicaudatus*) occur together, as in Dominica, they may readily be differentiated by this means alone. No doubt skins would show specific color differences, but I have had none from the West Indies.

I am unable to detect any important characters separating the Jamaican and Lesser Antillean representatives of *Molossus obscurus* from *M. verrilli* of San Domingo, and therefore use the latter name in a subspecific sense to include them all provisionally at least. In addition to the series from Jamaica, the Museum of Comparative Zoölogy has specimens from Sta. Lucia and Dominica. It doubtless occurs also on the other Lesser Antilles and Porto Rico; but I have examined no specimens, and the published records seem uncertain. Dobson (1878), however, records *obscurus* from St. Thomas, and Feilden (1890) notes it from Barbados. The statement of the latter, that there is a great difference in the size of individuals as seen on the wing, probably indicates that both *crassicaudatus* and the present form occur there.

MOLOSSUS CRASSICAUDATUS E. Geoffroy.

Molossus crassicaudatus E. Geoffroy, Ann. Mus. Hist. Nat. Paris, 1805, **6**, p. 156.

This small, dark-colored Molossus is common in Grenada, and lives in colonies underneath the roofs of houses. Buildings covered with galvanized iron sheeting are especially favored by it since the small holes left open where the convexities of the sheeting meet the rafters afford ready ingress to the spaces between ceiling and roofing. A large colony inhabited the roof of a cottage at St. George's, and here a small series was easily obtained by placing a dipnet over one of the openings. The owner of the house told us that the bats were active all night, constantly coming and going. Their strong odor and sharp chattering notes render their presence rather obnoxious. They commence flying while it is still light, even before the sun has quite disappeared. Their flight is high and rapid, and on several occasions towards evening we saw them in some numbers hawking over a hill at the same time with a few Swifts (Chaetura). The flight of the two was very similar, and seemingly of about the same velocity, without much doubling or dodging, so that at a distance it was sometimes difficult at first glance to distinguish bird from mammal. The distinct bend of the wing at the carpus in the bat, however, was quite diagnostic in the failing light.

We kept some ten or more of these bats in a net during an entire night and day, and noticed that during the night they made no effort to escape, but all hung in a solid cluster, apparently at rest, though at times one would utter a sharp trill or chirrup. During the succeeding day they maintained their position, but appeared to be sleeping, and felt decidedly cool to the touch.

One of the specimens (No. 7448) is of special interest, in that it has a second lower incisor on the left side, a mere spicule, yet of the same vertical height as the central bilobed incisor. This extra incisor is thus, no doubt, a reversion to the condition shown by the closely related genera Eumops and Promops, in which there are normally two lower incisors on each side, both, however, bilobed.

As pointed out by the writer in a previous paper (1908, p. 59) *Molossus crassicaudatus* is a wide-ranging species whose characters are very constant. It inhabits the continent of South America from Argentine to Panama, and north among the Lesser Antilles, whence the Museum has specimens from Sta. Lucia, Dominica, and St. Vincent in addition to the series from Grenada. Dr. J. A. Allen (1890, p. 169) has recorded from Virgin Gorda (just east of Porto Rico) a small black Molossus, with forearm 37 mm., third finger 72, which may be none other than this species, here probably near its northern limit. The diminutive *M. tropidorhynchus* of Cuba is even smaller (forearm 33).

What was probably this same bat was noted occasionally at Bathsheba and Hastings, Barbados, by Mr. Austin H. Clark; but none was secured. It may have been a bat of this early-flying species that Ligon saw captured by a hawk at Barbados. This interesting occurrence he relates as follows (Ligon, Hist. Barbadoes, 1673, p. 58): "And for Hawkes, I never saw but two, and those the merriest stirrers that ever I saw fly; and one of them was in an evening just at Sun setting, which is the time the Bats rise, and soare to a good hight; and at a downcome, this *Barbary* Faulcon took one of them and carried it away."

MOLOSSUS TROPIDORHYNCHUS Gray.

Molossus tropidorhynchus Gray, Ann. Nat. Hist., 1839, **4**, p. 6.

This very small Molossus (forearm 33) is known from Cuba only. It may there represent the little black *M. crassicaudatus* of the Lesser Antilles. It was found abundantly by Palmer under a tiled roof at Pinar del Rio in the western end of the island, as also at El Cobre.

CERCOPITHECIDAE.

CERCOPITHECUS MONA (Schreber).

Simia mona Schreber, Säugethiere, 1774, **1**, p. 97, pl. 15.

In the island of Grenada this monkey is found in small numbers and has evidently been introduced from the Cameroons or some adjacent part of West Africa. It has apparently been established here for a considerable period for all the persons of whom I made inquiries agreed that it had been there as long as they could remember. Possibly it was brought by the slave traders early in the last century. From inquiries and observations it appears that these monkeys are confined to the heavy primeval forest, a small area of which now remains on the hills in the interior of the island. During our week's stay at Grand Etang in the midst of this forest we noted two bands of these monkeys in the neighboring woods. The one was usually to be found among the lofty trees on the westerly shore of the lake — the Grand Etang. The other frequented the valley across the divide nearby to the south. Apparently there was also a third band in the forest east of the lake. I could learn nothing corroborative of various vague reports of the damage done by these animals to cocoa plantations and vegetable gardens near the woods. During the time of our stay, at all events, they were feeding on the nut-like fruits of certain large forest trees, of which they seem very fond. Notwithstanding the length of time that these monkeys must have been in the island, they seem not to have multiplied very greatly. They are usually rather shy and alert, although at times, prompted perhaps by curiosity, a few may steal quietly into the trees near the Grand Etang rest-house, but at once retreat to the forest if alarmed. Each of the bands observed appeared to have its own feeding ground over which it ranged. With caution it is often possible to approach close to them as they feed busily in the treetops; but they are exceedingly watchful and usually the first intimation of their presence is the sounding of an alarm by one of their number, a series of loud coughing barks — "*wok, wok, wok*" — about twenty times repeated. This seems to be given by one of the old males for the tone is much hoarser and more resonant than that of the single answering calls of the others. They scamper off through the treetops running along the branches and leaping or swinging from one tree to another, faster than a man on the ground can readily follow. On one occasion the series of alarm notes was heard an hour or more after darkness had fallen over the forest.

Cercopithecus sabaeus (Linné).

Simia sabaea Linné, Syst. Nat., ed. 12, 1766, **1**, p. 38.

For many years this monkey has lived in a feral state in Barbados and St. Kitts, where it has been introduced from West Africa. The time of its introduction is uncertain, but Ligon writing of Barbados in 1673, did not mention it among the mammals of the island. It probably came sometime during the next seventy-five years, for Hughes, in 1750, speaks of it in his work on the natural history of the island.

Mr. Austin H. Clark, who visited Barbados in 1903, writes me that owing to the almost complete deforestation of that place, it is found at only a few points. "In a patch of woodland on the Foster Hall estate, near Bathsheba, St. Joseph's, it is very frequently met with, especially in the early mornings after a rainy night. At such times the monkeys will often sit on the larger and more exposed branches of the trees and sun themselves. I once saw as many as half a dozen on a single large branch in this wood. At other times they are shy and secretive, but if a gun be fired anywhere in the vicinity it is almost certain to bring a response in the shape of a bulldog-like growl from one or more of these animals. Monkeys are also common in the woods along the upper reaches of Joe's River. This species is very destructive to fruit grown in the vicinity of the woods inhabited by it and will also raid vegetable gardens and sweet potato patches."

Apparently these monkeys have never been able to increase very greatly in Barbados. Hughes (1750) says that they "are not very numerous in this Island; They chiefly reside in inaccessible Gullies; especially where there are many Fruit trees. The greatest Mischief they do to the neighboring Planters is digging out of the Earth their

Yams and Potatoes, and sometimes breaking and carrying off a great many ripe Sugar-canes. As a Law of this Island provides a *Praemium* for destroying these, as well as Racoons, they yearly rather decrease than multiply." Schomburgk, in his History of Barbados written in 1848, states that this monkey was then nearly extinct, but this belief may have been due to his misapprehension that it was a native species of Cebus.

There seems to be no record of the introduction of this monkey into St. Kitts, though it is said to have become common there.

I have followed Pocock in using the specific name *sabaeus* in place of *callitrichus*, hitherto current for the green guenon.

Distribution.

* Fossil Species. — Authentic Records, + Specimens in Coll. M. C. Z.	St. Andrew's	Old Providence	Swan Ids.	Jamaica	Cuba	Isle of Pines	Haiti & S. Domingo	Mona	Porto Rico	Plana Keys	Watling's Id.	Long Id.	Andros	New Providence	Eleuthera	The Abacos	St. Thomas	Virgin Ids.	St. Croix	Anegada	Anguilla	St. Martin's	St. Bartholomew	St. Kitts	Barbuda	Antigua	Montserrat	Guadeloupe	Dominica	Martinique	Sta. Lucia	St. Vincent	Grenadines	Grenada	Barbados
Didelphys marsupialis insularis																				—									—			+		+	
Marmosa chapmani																																		+	
*Megalonyx rodens					—																														
Dasypus novemcinctus hoplites																																		+	
Odocoileus					—																														
Oryctolagus cuniculus																												—					—		—
Dasyprocta albida, antillensis, etc.																	—				?			—			—	—	—		+	+	—	+	
*Amblyrhiza inundata																					—	—													
Capromys pilorides					+		?																												
Capromys pilorides relictus						+																													
Capromys prehensilis					+		?																												
Capromys preh. gundlachi						—																													
Capromys melanurus					—																														
Capromys (G.) thoracatus			—																																
Capromys (G.) brownii				+																															
Capromys (G.) ingrahami							?			—																									
*Capromys columbianus					—																														

Plagiodontia aedium							—																												
Loncheres ? armatus																														—					
Oryzomys antillarum				—																															
Oryzomys victus																																—			
Megalomys desmarestii																														—					
Megalomys luciae																															—				
*Megalomys 'majori'																									—										
Mus musculus				—	—		+		—				—	—										+				—	—	—	—	—	—	+	—
Epimys rattus, et r. alexandrinus				—	—	+	—		—				—	—										—				—	—	—	—	—	—	+	—
Epimys norvegicus					—		—																						—						—
Mungos birmanicus				+	—		—		—								—		—												—	—		+	—
Procyon maynardi														+																					
Procyon minor																												—							
Procyon ? cancrivorus																																			—
Solenodon paradoxus							+																												
Solenodon cubanus					+																														
Peropteryx canina phaea																																		+	
Noctilio leporinus				—	—			—									—		—							—		—			+	+		+	
Chilonycteris macleayii					—																														
Chilonycteris m. fuliginosa							—																												
Chilonycteris m. inflata									—																										
Chilonycteris m. grisea				—																															
Chilonycteris parnellii				+																															
Chilonycteris p. boothi					—																														
Chilonycteris p. portoricensis									—																										
Pteronotus davyi																													+						
Mormoops blainvillii				—																															
Mormoops b. cinnamomea					—		—	—																											

Distribution — Continued.

* Fossil Species.
— Authentic Records.
+ Specimens in Coll. M. C. Z.

	St. Andrew's	Old Providence	Swan Ids.	Jamaica	Cuba	Isle of Pines	Haiti & S. Domingo	Mona	Porto Rico	Plana Keys	Watling's Id.	Long Id.	Andros	New Providence	Eleuthera	The Abacos	St. Thomas	Virgin Ids.	St. Croix	Anegada	Anguilla	St. Martin's	St. Bartholomew	St. Kitts	Barbuda	Antigua	Montserrat	Guadeloupe	Dominica	Martinique	Sta. Lucia	St. Vincent	Grenadines	Grenada	Barbados
Otopterus waterhousii							—																												
Otopterus w. jamaicensis				+																															
Otopterus w. minor					+	—																													
Otopterus w. compressus												—	—	+	—																				
Lonchorhina aurita														—																					
Vampyrus spectrum				—																															
Glossophaga longirostris																																?	+	+	
Glossophaga soricina antillarum				—										?																					
Monophyllus redmani				—																															
Monophyllus cubanus					—																														
Monophyllus portoricensis									—																										
Monophyllus clinedaphus							?																												
Monophyllus luciae																															—				
Monophyllus plethodon																																			—
Hemiderma perspicillatum				—																														—	
Sturnira lilium				—																									+						
Brachyphylla cavernarum																																+			—
Brachyphylla nana					+																														
Artibeus jamaicensis	—	—		+			—		—									—		—	—	—		—		—									
Artibeus j. parvipes					—	—																													

Artibeus j. palmarum																																—			
Artibeus j. praeceps																												—	—						
Artibeus p. grenadensis																																		+	
Ardops haitiensis							—																												
Ardops montserratensis																											—								
Ardops nichollsi																													—						
Ardops luciæ																															—				
Phyllops falcatus					—																														
Ariteus achradophilus				—																															
Phyllonycteris poeyi					—																														
Reithronycteris aphylla				—																															
Erophylla sezekorni					—																														
Erophylla santa-cristobalensis							—																												
Erophylla bombifrons									—																										
Erophylla planifrons												—		—	—	+																			
Natalus stramineus																													—						
Natalus s. major							—																												
Chilonatalus brevimanus		—																																	
Chilonatalus micropus				—	—																														
Chilonatalus tumidifrons											—					+																			
Nyctiellus lepidus					—	—																													
Myotis dominicensis																													—						
Eptesicus fuscus cubensis					—																														
Eptesicus f? bahamensis														+																					
Nycticeius humeralis cubanus					—																														
Lasiurus pfeifferi					—																														
Lasiurus borealis ? seminolus														+																					
Lasiurus sp.				—																															

Distribution. — *Continued.*

* Fossil Species. — Authentic Records. + Specimens in Coll. M. C. Z.	St. Andrew's	Old Providence	Swan Ids.	Jamaica	Cuba	Isle of Pines	Haiti & S. Domingo	Mona	Porto Rico	Plana Keys	Watling's Id	Long Id.	Andros	New Providence	Eleuthera	The Abacos	St. Thomas	Virgin Ids.	St. Croix	Anegada	Anguilla	St. Martin's	St. Bartholomew	St. Kitts	Barbuda	Antigua	Montserrat	Guadeloupe	Dominica	Martinique	Sta. Lucia	St. Vincent	Grenadines	Grenada	Barbados
Nyctinomus brasiliensis musculus				+	—		+		+																										
Nyctinomus b. bahamensis												—			—	+																			
Nyctinomus b. antillularum																							+	+			—		—		—				
Nyctinomus macrotis				—	—																														
Mormopterus minutus					—																														
Eumops glaucinus					—																														
Eumops orthotis				—																															
Molossus obscurus verrilli				+			—										—												+		+				?
Molossus crassicaudatus																													+		+	+	—	+	?
Molossus tropidorhynchus					—																														
Cercopithecus mona																																		+	
Cercopithecus sabaeus																								—											—

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REPORTS ON THE SCIENTIFIC RESULTS OF THE EXPEDITION TO THE EASTERN TROPICAL PACIFIC, IN CHARGE OF ALEXANDER AGASSIZ, BY THE U. S. FISH COMMISSION STEAMER "ALBATROSS," FROM OCTOBER, 1904, TO MARCH, 1905, LIEUT. COMMANDER L. M. GARRETT, U. S. N., COMMANDING.

XXII.

NEW GENERA AND SPECIES OF DINOFLAGELLATES.

By Charles Atwood Kofoid and Josephine Rigden Michener.

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No. 7.— *Reports on the scientific results of the Expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, by the U. S. Fish Commission Steamer "Albatross," from October, 1904, to March, 1905,* Lieut. Commander L. M. Garrett, U. S. N., *Commanding.*

XXII.

New genera and species of Dinoflagellates.

By Charles Atwood Kofoid and Josephine Rigden Michener.

The continued examination of the collections of the Expedition has brought to light a number of new species in addition to those previously described by the senior author (1907). Among them are representatives of two new genera, Peridiniella, related to Peridinium, and Berghiella of indeterminable relationships. Figures, fuller descriptions, and discussion of distribution will appear in a later memoir. A map giving location of stations will be found in the earlier paper (1907) and full data pertaining to them in Mr. Agassiz's account (1906) of the Expedition.

Throughout the descriptions the terms right and left are used as in the organism, not on figures. Transdiameters are measured at the girdle margin, excluding fins, unless otherwise stated. A description of the system of nomenclature of plates will be found in a paper by the senior author (1909).

The following is a list of the species described or discussed in this paper.

DINOFLAGELLIDIA.

DINIFERIDA.

PERIDININA.

Ceratiidae.

1. Gonyaulax acuta
2. Gonyaulax expansa
3. Gonyaulax subulata
4. Gonyaulax areolata
5. Gonyaulax minuta
6. Gonyaulax pavillardi
7. Gonyaulax reticulata
8. Gonyaulax senta
9. Gonyaulax paucula
10. Gonyaulax inclinata

11. Gonyaulax bispinosa
12. Amphidoma curtata
13. Amphidoma depressa
14. Amphidoma spinosa
15. Amphidoma elongata
16. Amphidoma laticincta
17. Amphidoma obtusa
18. Goniodoma reticulata
19. Goniodoma crassa
20. Protoceratium cancellorum
21. Protoceratium globosum
22. Protoceratium pellucidissimum
23. Protoceratium pepo
24. Protoceratium promissum
25. Peridiniella sphaeroidea
26. Peridinium annulatum
27. Peridinium corniculum
28. Peridinium hyalinum
29. Peridinium karsteni
30. Peridinium nodulosum
31. Peridinium pacifica
32. Peridinium poucheti
33. Heterodinium angulatum
34. Heterodinium elongatum
35. Heterodinium laeve
36. Heterodinium lineatum
37. Heterodinium minutum
38. Heterodinium spiniferum

OXYTOXINAE.

39. Centrodinium expansum
40. Centrodinium porulosa
41. Oxytoxum breve
42. Oxytoxum curvatum
43. Oxytoxum recurvum
44. Oxytoxum robustum

DINOPHYSIDAE.

45. Phalacroma circumcincta
46. Phalacroma favus
47. Phalacroma fimbriata
48. Phalacroma gigantea
49. Phalacroma limbata
50. Phalacroma porosa
51. Phalacroma praetexta
52. Phalacroma pulchra
53. Phalacroma turbinea
54. Dinophysis collaris
55. Dinophysis expulsa
56. Dinophysis rugosa
57. Amphisolenia astragulus
58. Amphisolenia quadricauda
59. Amphisolenia truncata
60. Histioneis diomedeae
61. Histioneis costata
62. Histioneis elongata
63. Histioneis hippoperoides
64. Histioneis hyalina
65. Histioneis inclinata
66. Histioneis inornata
67. Histioneis karsteni
68. Histioneis panda
69. Histioneis reginella
70. Histioneis rotundata
71. Histioneis striata
72. Ornithocercus formosus
73. Ornithocercus orbiculatus

AMPHITHOLIDAE.

74. Amphitholus quincuncialis Kofoid

INCERTAE SEDIS.

75. Berghiella perplexa

GONYAULAX Diesing.

The plates in this genus are an apical series of three to six plates (1′–3′ to 6′), an incomplete series of anterior intercalaries (0^a–4^a), six precingulars (1″–6″), six girdle plates (1–6), six postcingulars (1‴–6‴), one posterior intercalary (1^p), and one antapical (1⁗).

Subgenus FUSIGONYAULAX Kofoid.

The *acuta* group.

Biconical species with apical and antapical horns.

GONYAULAX ACUTA, sp. nov.

A large biconical species resembling *G. expansa*, sp. nov., but differing from it in size, form of ventral area and antapical horn, and in surface markings. Length nearly 2 transdiameters, midbody rounded; epitheca abruptly contracted to truncate apical horn, antapex more tapering, acuminate, nearly symmetrical. Girdle descending, displaced 1.5 girdle widths. Ventral area very narrow throughout, deeply indenting epitheca, not widely flaring posteriorly, terminating asymmetrically on right postmargin. Ventral pore on apical 3′. Plate formula 3′, 0^a, 6″, 6, 6‴, 1^p, 1⁗. Apical 1′ slender; precingular 6″ quadrangular; postcingular 1‴ minute, squarish; posterior intercalary 1^p elongated, carried out on antapical horn; antapical 1⁗ forming stout antapical spine, most exposed dorsally. Surface areolate with few linear riblets, sparsely porulate.

Length, 100 μ; transdiameter, 48 μ.

Sta. 4719.

GONYAULAX EXPANSA, sp. nov.

A medium sized biconical species flaring widely at the girdle, resembling *Spiraulax jolliffei* (Murr. and Whitt.) in form. Length 1.7 transdiameters. Epitheca abruptly contracted to a tapering, truncate, apical horn. Antapex acuminate, asymmetrical. Girdle descending, displaced 2 girdle widths.

Ventral area indents epitheca, abruptly widened posteriorly. Ventral pore in apical 2′. Precingular 6″ quadrangular; postcingular 1′ very narrow; posterior intercalary not extending on antapical horn; antapical 1⁗ a conical asymmetrical horn. Plate formula 3′, 0^a, 6″, 6, 6‴, 1^p, 1⁗. Surface reticulate, pores in corners of polygons.

Length 75 μ; transdiameter, 48 μ.

Sta. 4722.

Gonyaulax subulata, sp. nov.

A very small biconical species with overhanging girdle and faint linear markings. Length 1.66 transdiameters. Midbody subrotund, contracted abruptly into a tapering truncate apical horn. Antapex subulate. Girdle descending, displaced 1.6 girdle widths, ends overhanging slightly. Ventral area short, sigmoid, not indenting epitheca, broadly rounded posteriorly, not reaching postmargin. Plate formula 3′, 0^a, 6″, 6, 6‴, 1^p, 1⁗. Apical 1′ very narrow; precingular 6″ quadrangular; postcingular 1‴ very minute; posterior intercalary not on antapical horn, short and wide; antapical 1⁗ conical, exposed ventrally, terminating in a sharp subulate antapical spine. Surface smooth, sparingly marked with linear vermiculations in which lie the few scattered pores.

Length 48 μ; transdiameter 27 μ.

Sta. ——

Subgenus Gonyaulax.

The *spinifera* group.

Characterized by several asymmetrical antapical spines, absence of linear markings, and rotund body.

Gonyaulax areolata, sp. nov.

A minute rotund species with short apical horn and areolate surface. Length 1.15 transdiameters. Rotund, apical horn less than 2 girdle widths high, apex squarely truncate. Hypotheca hemispherical, bearing 2, 3, or more unequal, acute, finned, antapical spines. Girdle descending, displaced scarcely a girdle width, without overhang, with ribbed lists. Ventral area nearly straight, gradually widened distally, reaching postmargin, with spinous lists. Ventral pore in apical 3′. Plate formula 3′, 0^a, 6″, 6, 6‴, 1^p, 1⁗. Apical 1′ widened below its middle; precingular 6″ quadrangular, postcingular 1‴ narrow; posterior intercalary very wide. Surface minutely and densely areolate, few pores.

Length, 40 μ; transdiameter, 35 μ.

Sta. 4717.

The *polygramma* group.

Characterized by prevalence of linear markings.

GONYAULAX MINUTA, sp. nov.

A minute subspheroidal species with barely suggested apical horn with oblique apex. Length 1.1 transdiameters. Apex tilted to the left. Hypotheca hemispherical. Girdle descending, displaced 1 girdle width. Ventral area not indenting epitheca, terminating posteriorly in broadly rounded expansion. Ventral pore in apical 3′. Plate formula 3′, 0^a, 6″, 6, 6‴, 1^p, 1⁗. Apical 1′ widened posteriorly; precingular 6″ nearly square; postcingular 1′ minute, triangular; posterior intercalary wide. Surface smooth or faintly marked with linear striae. Girdle striate. No spines or lists.

Length 20–25 μ; transdiameter, 18–20 μ.

Sta. 4720.

GONYAULAX PAVILLARDI, sp. nov.

A small rotund or subangular species with predominantly linear markings. Length 1.1 transdiameters. Body rotund, angled at apical-precingular suture. Epitheca gradually contracted into short (1.5 girdle widths) squarely truncate, apical horn. Hypotheca asymmetrically rounded, fuller on left side. Ventral pore on apical 3′. Girdle descending, displaced 1 girdle width, no overhang. Ventral area acutely and deeply indenting the epitheca, nearly straight, its posterior plate subcircular, reaching postmargin, and often bearing several antapical spinules. Plate formula, 3′, 0^a, 6″, 6, 6‴, 1^p, 1⁗. Apical 1′, narrow, widened posteriorly; precingular 6″ quadrangular; postcingular 1‴ very slender, less than 0.5 girdle width across; posterior intercalary wide, antapical 1⁗ mainly dorsal in exposure. Surface sparingly reticulate with mainly longitudinal markings. Double ribs along sutures. Pores in lines.

Length, 48 μ; transdiameter, 44 μ.

Sta. 4717.

GONYAULAX RETICULATA, sp. nov.

A small to medium sized species resembling *G. polygramma* Stein but entirely without the characteristic linear markings. Body rounded, in smaller forms scarcely angled at apical-precingular suture. Length 1.3 transdiameters. Epitheca contracted to a stout apical horn with truncate apex. Hypotheca subhemispherical. Girdle descending, displaced 1.5 to 2 girdle widths, no overhang. Ventral pore on apical 3′. Ventral area indents epitheca, slightly curved, enlarged distally to left, reaching postmargin. Plate formula, 3′, 0^a, 6″, 6, 6‴, 1^p, 1⁗. Apical 1′ very narrow, curved to right posteriorly; precingular 6″ quadrangular; postcingular 1′ very narrow; posterior intercalary long and narrow. Without lists, with or without two short, finned, antapical spines. Surface coarsely and regularly reticulate. Sutures ribbed, often marked by intercalary bands.

Length, 50 to 65 μ; transdiameter, 45 to 50 μ.

Sta. 4724.

The *sphaeroidea* group.

Characterized by spherical form.

Gonyaulax senta, sp. nov.

A small species of spheroidal form, impressed girdle, and spinous hypotheca. Length 1.1 transdiameters. Epitheca with low (0.5 girdle width) squarely truncate apical horn. Hypotheca subhemispherical. Girdle descending, displaced 2 girdle widths, with slight overhang. Ventral area acutely indents epitheca, straight and narrow, and scarcely excavated posteriorly, not indenting antapical plate. No ventral pore. Plate formula, 3′, 0^a, 6″, 6, 6‴, 1^p, 1⁗. Apical 1′ minute, not reaching anterior plate of ventral area, apical 3′ short; precingular 6″ small, triangular; postcingular 1‴ and posterior intercalary small; antapical 1⁗ very large. Girdle impressed, with low fins. Surface of epitheca minutely and faintly areolated, and with faint scattered reticulations, that of hypotheca without reticulations, abundantly covered with minute spinules, about seventy-five on its ventral face, longest on the antapical plate.

Length, 58 μ; transdiameter, 52 μ.

Sta. 4683.

Gonyaulax paucula, sp. nov.

A very minute species with subspheroidal form, feebly developed girdle, and smooth surface. Body nearly spheroidal, length 1.1 transdiameters, girdle section circular. Epitheca less than hypotheca, its altitude about 0.5 transdiameter. Hypotheca slightly exceeding a hemisphere, its altitude about 0.6 transdiameter. Girdle descending, displaced nearly 1 girdle width, without overhang. Its furrow not impressed, slight ridge at its anterior margin, no posterior structure to mark suture or at most a feeble ridge, as in Heterodinium. Ventral area not impressed, not indenting epitheca, not spreading distally, its total length 0.6 transdiameter. Plate formula 3′, 3^a, 6″, 6 (?), 6‴, 1^p, 1⁗. Apical 1′ curved or angled to the left. Intercalaries dorsal, 2^a smallest. Precingular 6″ quadrangular, postcingular 1‴ nearly square. Posterior intercalary horizontally elongated. Surface smooth with few scattered pores or numerous small ones.

Length 20 μ; transdiameter, 18 μ.

Sta. 4720.

Subgenus Steiniella (Schütt) Kofoid.

The *fragilis* group.

Characterized by apex carried on to dorsal surface and very fragile theca.

Gonyaulax inclinata, sp. nov.

A large, broadly rounded, asymmetrical species with short, slender, oblique, apical horn. Length equals transdiameter. Body rotund, flattened posteriorly. Epitheca contracted abruptly into a short (2 girdle widths), conical, truncate, apical horn tilted (15°) to right. Hypotheca asymmetrical. Antapex concave, with list with numerous spinules. Girdle descending, displaced 2.5 girdle widths, ends not meeting in median line by 1.5 girdle widths. Ventral area deeply and squarely indenting epitheca, nearly straight, scarcely widens distally to postmargin. Plate formula 4′, 0^a, 6″, 6, 6‴ (?), 1^p, 1⁗. Apical 1′ widening posteriorly to square junction with ventral area; precingular 6″ pentagonal; posterior intercalary large; antapical 1⁗ relatively small. Surface minutely and prominently reticulate. Pores in angles of areas.

Length, 75 μ; transdiameter the same.

Sta. 4737.

The *bispinosa* group.

Characterized by two widely separated prominent antapical spines, and premedian girdle.

Gonyaulax bispinosa, sp. nov.

A very large, elongated, rotund species with two prominent antapical spines whose fins extend to the girdle. Body elongated, length 1.3 transdiameters. Girdle premedian, epitheca only about half the length of hypotheca. Epitheca convex, no apical horn, greatly elongated apical carries closing platelet on to dorsal face. Hypotheca constricted behind girdle, then expanding to rotund sac-like antapex. Girdle descending, displaced 2 girdle widths, scarcely impressed, with high hyaline lists, no overhang. Ventral area very narrow as far as to the large elliptical posterior plate which does not reach to antapex. Plate formula 4′, 1^a (?), 6″, 6, 6‴, 1^p, 1⁗. Apical 1′ very narrow, 2′ and 3′ wide, and 4′ narrow, precingular 6″ quadrangular; postcingular 1‴ short; posterior intercalary and antapical 1⁗ very large. Surface smooth, with prominent spinulate ridges along suture lines and numerous longitudinal striae. Two antapical spines, 2.5 girdle widths long and 0.7 transdiameters apart, each with hyaline fins which run anteriorly to the girdle.

Length 75 μ; transdiameter, 55 μ.

Sta. 4699.

AMPHIDOMA Stein.

The plate formula of this genus is $6'$, 0^a, $6''$, 6, $6'''$, 1^p, $1''''$.

AMPHIDOMA CURTATA, sp. nov.

Epitheca high, greatly exceeding hypotheca, fuller upon the right side, its altitude 1 transdiameter, its sides convex. Apex truncate, displaced to right. Hypotheca scarcely developed, forming a very low dome, only a girdle width in altitude, fuller upon the right side. Girdle not displaced, slightly impressed no lists. Ventral area acutely indenting epitheca for 0.5 girdle width, extending nearly to antapex without expansion. Plate formula 6 (?), 0^a, $6''$, 6, $6'''$, 1^p, $1''''$. Apical $1'$ slender, reaching to anterior plate of ventral area. Other apicals short, less than 0.25 transdiameter in length; precingular $6''$ slender, its width 1 and its length 5 girdle widths; postcingular $1'''$ small, squarish; posterior intercalary and antapical $1''''$ about equal. Surface finely, faintly and regularly reticulate.

Length 30 μ; transdiameter, 23 μ.

Sta. 4733.

AMPHIDOMA DEPRESSA, sp. nov.

A minute depressed species, low, top-shaped, with wide intercalary bands. Length equals transdiameter. Body biconical, epitheca exceeding hypotheca, its altitude 0.45 transdiameter, its sides straight, contracted abruptly to a scarcely differentiated apical horn about 0.75 girdle width in altitude. Hypotheca very low, its altitude 0.35 transdiameter, convex, contracted to a low, obtuse, median antapical horn, 1 girdle width across and 0.5 in length. Girdle not displaced, very slightly impressed, without lists. Ventral area acutely indents the epitheca, passing posteriorly 2 girdle widths with little expansion to an acute end, guarded by low lists. Plate formula $6'$, 0^a, $6''$, 6, $6'''$, 1^p, $1''''$. Apicals $1'$, $2'$, $6'$ narrow, covering about 0.75 of the apex. Apical $1'$ asymmetrically diamond-shaped, not fully parting precingular $1''$ and $6''$ and scarcely meeting the ventral area; precingular $6''$ pentagonal; postcingular $1'''$ small rectangular; posterior intercalary crowding on to the antapex. Surface smooth, except for striate intercalary bands along nearly all sutures in precingular, girdle, and postcingular series.

Length, 27 μ; transdiameter, 27 μ.

Sta. 4733.

AMPHIDOMA SPINOSA (Kofoid).

Murrayella spinosa Kofoid (1907) belongs in this genus.

AMPHIDOMA ELONGATA, sp. nov.

Resembling *A. acuminata* Stein in form but more obtuse anteriorly and with its bluntish antapical horn curved a little ventrally. Body elongated, biconical, its length 2 transdiameters. Epitheca and hypotheca equal in altitude, both with concave sides, except near girdle end on right face of hypotheca which is fuller. Apex somewhat abruptly rounded to small apical closing platelet. Antapex blunt, curved ventrally beyond basal constriction, without acicular spinule of *A. acuminata*. Girdle scarcely displaced, slightly impressed. Ventral area very slightly indenting epitheca, widening to the right to 0.7 girdle width just beyond the girdle and attenuate posteriorly, its total length only 3 girdle widths, guarded by two minute lists. Plate formula 6′, 0^a, 6″, 6, 6‴, 1^p, 1⁗. Apical 1′ an elongate, asymmetrical rhomb, other apicals 0.66 transdiameter in length; precingular 6″ pentagonal; postcingular 1‴ small, triangular; posterior accessory large, 2 girdle widths across; antapical 1⁗ asymmetrical. Surface smooth, ventral pore on right edge of apical 1′. Faintly striate intercalary band along apical-precingular suture.

Length 35 to 45 μ; transdiameter, 18 to 23 μ.

Sta. 4720.

AMPHIDOMA LATICINCTA, sp. nov.

A minute spheroidal species with smooth surface. Body almost a perfect sphere, its length not exceeding 1.05 transdiameters. Epitheca and hypotheca equal, hemispherical, the apex slightly contracted and a slight depression sometimes seen at apical-precingular suture. Girdle not displaced, relatively wide, scarcely impressed, without lists. Ventral area not indenting the epitheca, less than a girdle width across at posterior margin of girdle, attenuate, and extending posteriorly less than two girdle widths, with two small lists overhanging flagellar pore. Plate formula 6′, 0^a, 6″, 6, 6‴, 1^p, 1⁗. Apical 1′ narrower than other apicals, asymmetrically diamond-shaped, not parting precingulars 1″ and 6″ to meet the ventral area. Precingulars a trifle shorter than apicals. Postcingular 1‴ very minute, nearly rectangular, posterior intercalary elongated laterally, narrow. Surface smooth and structureless except for faint surface lines and intercalary band at apical-precingular suture. Ventral pore at midventral posterior tip of apical 1′.

Length 18 μ; transdiameter, 17 μ.

Sta. 4720.

AMPHIDOMA OBTUSA, sp. nov.

Body less elongated than in *A. acuminata,* antapex broadly rounded. Length 1.42 transdiameters. Epitheca conical, sides scarcely convex, its altitude 0.6 transdiameters, equalling hypotheca. The latter with nearly straight sides and very broadly rounded antapex. Girdle very shallow, descending, displaced 0.3 girdle width. Ventral area straight, extending posteriorly barely 2 girdle widths to asymmetrically rounded end, scarcely impressed. Plate formula 6′, 0^a, 6″, 6, 6‴, 1^p, 1. Apical 1′ asymmetrically diamond-shaped, extending posteriorly to ventral area; the other apicals shorter, nearly twice the length of the precingulars; precingular 6″ squarish; postcingular 1‴ minute, subtriangular; posterior intercalary wide, 1.5 by 2 girdle widths. Surface smooth, faint intercalary band at apical-precingular suture.

Length, 27 μ; transdiameter, 18 μ.

Sta. 4720.

GONIODOMA Stein.

Theca composed of three apicals, 1′ to 3′, about a depressed closing platelet, no anterior intercalaries, seven precingulars, 1″ to 7″, six girdle plates, 1 to 6, plus two additional platelets in region of ventral area, five postcingulars, 1‴ to 5‴, no posterior intercalary, and three antapicals, 1⁗ to 3⁗. The ventral area is made up of five platelets in addition to the two in the level of the girdle.

GONIODOMA RETICULATA, sp. nov.

A small spheroidal species with porulate epitheca, and hypotheca very irregularly covered with a coarse, heavy but imperfect reticulum. Differs from *G. acuminata* var. *tener* Schütt (1895) pl. 7, fig. 31, in structure at girdle junction and in surface markings. Body spheroidal, length 1.1 transdiameters. Epitheca exceeds hypotheca, its altitude 0.65 transdiameter, hemispherical, spreading somewhat at the girdle, apical area not projecting. Hypotheca depressed hemispherical, its altitude 0.4 transdiameter. Girdle postmedian, descending, displaced one girdle width, distal end curved posteriorly, impressed, with low, hyaline, irregularly ribbed lists. Ventral area short, 3 girdle widths in length and 1.5 in width, arched to the right, with spinous lists on either side. Apical area triangular with elliptical pit. Ventral pore in anterior margin of precingular 1″. Antapicals 1⁗ and 3⁗ small, unequal, 1⁗ much like a posterior intercalary of Gonyaulax. Antapical 2⁗ large, quadrangular. Surface of epitheca irregularly marked with areoles of various sizes. Hypotheca with loose, imperfectly anastomosing mesh work.

Length, 40 μ; transdiameter, 36 μ.

Sta. 4722.

Goniodoma crassa, sp. nov.

A large species with flaring narrow girdle, pointed antapex, and pitted, porulate areas of plates greatly reduced and remainder covered by faint irregular depressions. Body stout, ellipsoidal, with spreading girdle, and antapex abruptly contracted to a stout, asymmetrical, blunt projection. Length 1.07 transdiameters. Epitheca less than hypotheca, dome-shaped, spreading immediately at the girdle, its altitude 0.47 transdiameter. Apex broadly rounded, apical area triangular, with circular, sunken platelet. Hypotheca of similar form but fuller upon the left side and contracted distally to a stout, blunt, asymmetrical projection deflected to the right, 0.07 transdiameter high and 0.14 across its base. Girdle very narrow, 0.038 transdiameter across, descending, displaced distally 2 girdle widths, distal end deflected posteriorly in a sweeping curve and the proximal end abruptly curved in the same direction, deeply impressed, V-shaped. Ventral area short and wide. Apical plates small. Antapicals $1''''$ and $3''''$ exposed ventrally, and $2''''$ dorsally. Surface with faint ridges along sutures, pitted, porulate areas reduced to about one fourth of each plate, remainder with faint depressions of irregular shape and distribution and without pores. No lists or spines. Wall thick.

Length, 94 μ; transdiameter, 88 μ.

Sta. 4739.

Protoceratium (Bergh) Kofoid emend.

Plate formula $2'$, 0^a, $6''(?)$, 6(?), $6'''$, 0^p, $3''''$. Apical $1'$ narrow, midventral, $2'$ large encircling rest of anterior end. Apical area present as in Gonyaulax, sometimes obscured in the mesh. No anterior intercalaries. Precingular $1'$ minute (always present ?). Postcingular $1'''$ small. Posterior intercalary probably shifted into antapical group. Antapicals $1''''$ and $3''''$ nearly bilaterally symmetrical, $2''''$, large, dorso-terminal. Surface coarsely and heavily marked with polygonal mesh of heavy ribs.

Protoceratium cancellorum, sp. nov.

A large, remotely subglobular species with exceedingly coarse mesh. Length 1.08 transdiameters. Girdle section very broadly reniform. Epitheca 0.5 altitude of hypotheca, low dome-shaped, sides only slightly convex. Apex rounded. Hypotheca laterally contracted immediately behind girdle, 0.3 wider dorso-ventrally than transversely, antapex broadly and symmetrically rounded. Girdle descending, displaced scarcely 1 girdle width, without overhang, its furrow deep and narrow, with heavy hyaline non-ribbed lists. Ventral area 0.5 transdiameter in total length, arched to the right with hyaline fin on right margin. Surface with remarkably coarse polygonal meshwork, wider along meridional sutures, smaller in center of plates. Three rows and an apical group of polygons on epitheca, five and an antapical group on hypotheca. Numerous minute scattered pores.

Length, 85 μ; transdiameter, 70 μ.

Sta. 4697.

PROTOCERATIUM GLOBOSUM, sp. nov.

A spheroidal species of medium size, with delicate polygonal mesh of medium size, without lists or spines. Body almost perfectly spherical, except for depressed ventral area. Length, 1.11 transdiameters. Epitheca equals hypotheca, both apex and antapex slightly flattened. Apical area minute. Girdle descending, displaced 0.66 girdle width, its furrow scarcely at all impressed, guarded by low, hyaline, ribbed lists. Ventral area impressed, expanding to the right, its length from anterior girdle lists 0.57 transdiameter. Surface covered with a network of irregular polygons, sutures faint. Polygons numerous, about five rows and an apical group on epitheca, and six and an antapical group on hypotheca. No pores. Very translucent.

Length, 58 μ; transdiameter, 52 μ.

Sta. 4737.

PROTOCERATIUM PELLUCIDISSIMUM, sp. nov.

A minute spheroidal species with apical horn, remarkably large polygonal mesh, and excessive transparency. Body subspheroidal. Length 1.13 transdiameters, girdle subcircular with slight ventral flattening. Epitheca exceeded by hypotheca, its altitude 0.45 transdiameter, subconical, sides somewhat convex, contracted distally into an asymmetrical apical horn 1 girdle width in height and a small, somewhat oblique apex. Hypotheca hemispherical, its altitude 0.6 transdiameter. Girdle descending, displaced 1 girdle width, its furrow not impressed, guarded by hyaline lists with few ribs. Ventral area short and narrow, its length from anterior girdle list but 0.5 transdiameter and its width 1 girdle width, distally contracted. Surface covered with very large polygonal mesh of delicate character. Two rows and an apical group on epitheca, and two and an antapical on the hypotheca. Sutures not visible, antapical list with spinules present. No pores. Excessively transparent.

Length, 50 μ; transdiameter, 44 μ.

Sta. 4701.

Possibly not a Protoceratium.

PROTOCERATIUM PEPO, sp. nov.

A subellipsoidal species of medium size with coarse mesh. Body subellipsoidal with broadly rounded symmetrical apex and antapex. Length 1.3 transdiameters. Epitheca less than hypotheca, its altitude 0.5 transdiameter, its sides not sufficiently convex to be hemispherical or straight enough for a cone. Apex broadly rounded, apical area small. Hypotheca of similar form to epitheca but longer, its altitude 0.67 transdiameter. Girdle descending, displaced 1 girdle width, its furrow slightly impressed, with very low, hyaline non-ribbed lists. Ventral area very slightly widened to the right, with long hyaline fin on right margin, its length from anterior girdle list 0.65 transdiameter and its greatest width 1.45 girdle widths. Surface coarsely reticulate with rounded polygons, longer along faintly marked sutures, three rows and a distal group on each half of the theca. Ventral pore in small precingular 1″. Numerous scattered minute pores.

Length 46 μ; transdiameter, 36 μ.

Sta. 4681.

PROTOCERATIUM PROMISSUM, sp. nov.

A large species of elongated form with coarse mesh and light secondary reticulations along tropical sutures. Body elongated almost biconical. Length 1.6 transdiameters, girdle section circular, some ventral flattening. Epitheca less than hypotheca, its altitude 0.75 transdiameter, its sides nearly straight, apex squarely truncate, 1.3 girdle widths across. Hypotheca 0.86 transdiameter in altitude, sides sloping, nearly straight proximally, antapex broadly rounded. Girdle descending, displaced 0.4 girdle width, its furrow deeply impressed, with heavy ridges and very low, hyaline, non-ribbed lists. Ventral area spreading distally, angled on right with low fin, its length from anterior girdle list 0.78 transdiameter. Surface coarsely reticulate with somewhat rounded polygons, larger and longer near faintly marked sutures, smaller and more rounded in center of plates. Faint traces of secondary reticulations in places along the two tropical suture lines. Ventral pore in small precingular 1″. No pores.

Length, 70 μ; transdiameter, 43 μ.

Sta. 4739.

PERIDINIELLA, gen. nov.

Theca consisting of an apical series of plates (4), an incomplete zone of dorsal intercalaries (3), seven precingulars, six girdle plates, six postcingulars, one posterior intercalary, and one antapical. Resembles Peridinium in the dorsal intercalaries, and in number of precingular plates. Resembles Gonyaulax in form and relations of apical 1′, in the plates of the hypotheca, in the absence of an apical notch, and in the presence of a ventral pore. Type species, *P. sphaeroidea.*

PERIDINIELLA SPHAEROIDEA, sp. nov.

A spheroidal species with shallow furrows, and plates with coarsely reticulated patches. Body nearly spherical, its length 1.07 transdiameters, girdle section circular, apex not elevated. Epitheca equals hypotheca. Girdle descending, displaced 1.4 girdle widths, its ends not meeting midventrally by 1 girdle width, scarcely impressed, guarded by slightly everted ridges. Ventral area scarcely indenting epitheca; extending about 0.6 distance to antapex, terminating in subcircular area occupied by posterior plate of ventral area, nowhere deeply impressed. Plate formula, 4′, 3^a, 7″, 6, 6‴ (?), 1^p, 1⁗. Apical 1′, narrow, asymmetrical, bearing at its apex a subcircular closing platelet, and joining the ventral area posteriorly as in most species of Gonyaulax. Anterior intercalaries 1^a–3^a symmetrically located on dorsal face as in Peridinium. Precingular 7″ quadrangular. Postcingular 1‴ (?) less than 1 girdle width across and 2 in length. Posterior intercalary large, asymmetrically located, as is also the antapical 1⁗. Ventral pore midway between apex and proximal end of girdle at suture between apical 2′ and precingular 1″, next to apical 1′. Surface with smooth intercalary bands along meridional and tropical sutures, which isolate patches of coarse irregular reticulations which show a tendency towards a quadrilateral form. No lists or spines.

Length, 52 μ; transdiameter, 50 μ.

Sta. 4604.

PERIDINIUM ANNULATUM, sp. nov.

A large species with long, annulated apical and antapical horns. Belongs in the group with *P. fatulipes* Kofoid (1907), pl. 5, fig. 30, (syn. *P. tumidum* Okamura (?), *P. tesselatum* Karsten) and *P. kofoidi* Fauré-Fremiet (1908), pl. 16, fig. 12. It differs from *P. fatulipes* in greater elongation, narrower hypotheca, wider postmargin of ventral area, less spreading antapical horns, and in having the apical horn ringed with transverse riblets and the posterior horn similarly adorned for a greater distance. It differs from *P. kofoidi* in the long ventral notch which is not figured by Fauré-Fremiet, in the apical rings, in the much wider ventral area, and in the angle formed between the antapical horns (22° in *P. annulatum* and 52° in *P. kofoidi.* Length 1.66 transdiameters; width of narrowest part of hypotheca 0.45 transdiameter in girdle; length of antapical horns 0.5 transdiameter. Girdle not descending, its distal end curved anteriorly, not impressed, with hyaline, ribbed lists. Three dorsal anterior intercalary plates. Ventral area very wide, 0.22 transdiameter across, not deeply excavated and barely reaching postmargin.

Ventral notch long, narrow, its length 0.22 transdiameter. Surface finely and faintly reticulated with pores near nodes. Sutures marked by light rib. No intercalary bands seen.

Length, 74 μ; transdiameter, 44 μ.

Sta. 4705.

PERIDINIUM CORNICULUM, sp. nov.

A small, spheroidal species with very small, elongated apical horn, transverse ascending girdle, displaced one girdle width, and two slender antapical spines. Differs from *P. globulus* Stein and *P. quarnerense* (Br. Schröder) Broch in less displaced girdle, longer apical horn, and straighter ventral area; from *P. globulus* var. Karsten in longer apical, structure at girdle junction, and in two instead of four antapical spines; from *P. nodulosum* in size, in longer apical, and in surface markings. Midbody nearly spherical, length 1.04 transdiameters. Epitheca exceeds hypotheca, both hemispherical. Altitude of epitheca (excluding horn) 0.6, and of hypotheca (excluding spines) 0.38 transdiameter. Apical horn abruptly differentiated, a flaring tube 1.55 girdle widths in length and 0.33 to 0.66 in diameter with ventral notch running its whole length and widening distally, tilted to right. Antapical spines solid, finned, 2 girdle widths in length and 2 apart at base, slightly spreading, arising from edges of ventral area. Girdle and ventral area as in *P. nodulosum*. Surface faintly reticulate, sutures marked by single rib with striae on one side giving a pinnate appearance to these tracts.

Length, of midbody, 51 μ, total, 67 μ; transdiameter, 55 μ.

Sta. 4619.

PERIDINIUM HYALINUM, sp. nov.

A minute, plain, ellipsoidal species with equatorial, scarcely displaced girdle, without horns or spines. Resembles somewhat Fauré-Fremiet's *P.* indeterminé (1908), pl. 16, fig. 18, but differs in the absence of apical projection, distal asymmetry of central area, and in having a very slight displacement of the girdle. Body ellipsoidal, its length 1.16 transdiameters. Girdle section circular with slight ventral depression. Epitheca slightly exceeded by hypotheca, its altitude 0.5 transdiameter, subhemispherical, with slight suggestion of apical contraction. Ventral notch 0.6 girdle width long. Hypotheca hemispherical, its altitude 1.05 transdiameters. Girdle equatorial, descending, displaced only 0.4 girdle widths, its furrow very shallow, with low ridges but no lists. Ventral area nearly straight, reaching postmargin, slightly expanded to the left, with low lists on either side. Three dorsal anterior intercalary plates. Surface smooth and hyaline.

Length, 30 μ; transdiameter, 27 μ.

Sta. 4720.

PERIDINIUM KARSTENI, sp. nov.

A large species resembling *P. multistriatum* Kofoid (1907), pl. 30, figs. 40, 41, but differing in proportions and in form of the girdle. Body widely expanded at girdle, rounded pentagonal in ventral view with concave antapex and very short, acute antapical horns, the right slightly longer. Apex inclined ventrally. Epitheca a little less than hypotheca, its dorsal altitude 0.4 transdiameter, contracted distally to a small, short, apical horn. Hypotheca broadly rounded to region of short antapical horns. Distance between their tips 0.3 transdiameter, length of right 1 and of left 1.5 girdle widths. Postmargin irregularly concave, but the arc very shallow. Girdle descending, displaced 4 girdle widths, the proximal end ascending in a very abrupt curve, and the distal descending in a sweeping one from the right margin. Furrow impressed, with low ribbed lists. Ventral area 3 girdle widths wide, expanding just behind distal end of girdle, reaching postmargin. Three dorsal intercalary plates. Apical 1′, the rhomb plate, 3.5 girdle widths across. Ventral notch 2 girdle widths long. Surface with very wide, striate, intercalary bands and reduced reticulate-porulate areas of plates as in *P. multistriatum.* Width of dorsal postcingular band 0.27 transdiameter.

Length, 55 μ; transdiameter, 60 μ.

Sta. 4670.

PERIDINIUM NODULOSUM, sp. nov.

A small spheroidal species with minute apical horn, ascending girdle without overhang, and surface with scattered nodular elevations. Differs from *P. globulus* Stein in wider girdle without proximal curvature, and from *P. quarnerense* (Br. Schröder) Broch, in absence of overhang and less displacement of girdle, and from both in the surface markings. Body almost spheroidal. Length, excluding horn and spines, 1.05 transdiameters. Girdle section circular, with little ventral flattening on hypotheca. Epitheca equals hypotheca, both hemispherical. Apical horn minute, 0.4 girdle width across, and less in height. Ventral notch minute. Girdle ascending, without proximal or distal curvature, displaced 1 girdle width, with feeble marginal ridges, and very low (0.2 girdle width) hyaline fin. Ventral area curved, narrow, flagellar pore posteriorly located. Two antapical spines on postmargin of ventral area each 1.2 girdle widths in length, the right more distal in origin, both finned. The right side of ventral area with long low fin. Three dorsal intercalaries. Apical 1′ very broad, in contact with both precingular 1″ and 6″. Surface with scattered elevated nodules of irregular shape.

Length, of midbody, 42 μ, total 49 μ; transdiameter, 38 μ.

Sta. 4706.

PERIDINIUM PACIFICA, sp. nov.

A small species resembling *P. pellucidum* Bergh but with much displaced girdle and proportionately greater girdle section. Body very broadly pyriform, contracted to small apex, but with scarcely any differentiated apical horn. Length, excluding spines, 1.08 transdiameters. Epitheca exceeds hypotheca, its altitude 0.76 transdiameter, hemispherical near girdles, contracted to conical apex. Ventral notch 1.5 girdle widths long. Hypotheca low, dome-shaped, contracted distally to narrow postmargins. Two equal, solid, subulate antapical spines 1.5 girdle widths in length, 2.5 apart at base and 3 at apex, rise from slight rounded projections. Postmargin with shallow arch. Girdle ascending, displaced 2 girdle widths, scarcely completing the circuit, proximal end posteriorly deflected, furrow not impressed, with low hyaline, non-ribbed lists. Ventral area spreading to the right and reaching postmargin, without lists or spines. Three dorsal anterior intercalary plates. Surface porulate and minutely areolate, with striate intercalary bands 1 to 1.5 girdle widths across.

Length, midbody only, 62 μ, total, 66 μ; transdiameter, 57 μ.

Sta. 4732.

PERIDINIUM POUCHETI, sp. nov.

A small species with rotund body, short apical horn, short, close set, hollow antapical horns, ascending girdle and indenting postmargin. Differs from *P. pallidum* Ostenfeld in more rotund body, closer set, shorter antapicals. Differs from *P. adriaticum* Broch (1910), p. 192, fig. 8, in the same particulars, in less postmarginal excavation, and in greater displacement of girdle. It resembles *P. pellucidum* Bergh (1881) pls. 15, fig. 46, 47, in form of body but differs from it in greater extent of cavity in antapicals, more displaced girdle and stouter apical horn. Belongs to subgenus Protoperidinium rather than Euperidinium. Body elliptical with short, stout, apical, and slightly developed, partially hollow, subulate antapical horns. Total length 1.6, apical horn 0.2, antapicals 0.27 transdiameters. Girdle section circular. Epitheca equals hypotheca in total altitude, broadly hemispherical, contracted to tapering apical horn 1.5 girdle widths in height and 0.8 across apex. Ventral notch 1.3 girdle widths in length. Hypotheca subhemispherical, notched about 0.6 girdle width by postmargin. Antapical horns 0.27 transdiameter between centers of bases and 0.37 between tips, tapering subulate, distally formed of solid spines. Girdle ascending, displaced nearly 1 girdle width, not impressed, with ribbed, hyaline lists. Ventral area narrow, straight, with hyaline lists, but no posterior spinules. Surface finely and evenly reticulate throughout.

Length, 58 μ; transdiameter, 36 μ.

Sta. 4709.

HETERODINIUM ANGULATUM, sp. nov.

Bears a general resemblance to *H. hindmarchi* f. *maculata* Kofoid (1907), pl. 7, fig. 42, but differs in having both shoulders angled, the excavation between the antapical horns wider and less arched, the surface more coarsely reticulate. Length 1.33 transdiameters on anterior girdle list. Epitheca exceeds hypotheca, both shoulders almost right-angled, abruptly contracted to tapering apical horn. Hypotheca with symmetrical, slightly incurved, tapering, obtuse antapical spines, with the arched postmargin flattened in the central part. Anterior girdle list salient, shelf-like, posterior deficient. Surface very coarsely reticulated with irregular, porulate polygons. Wide intercalary bands smooth, or wholly, or partially reticulate with fine quadrangles.

Length, 85 μ; transdiameter, in girdle, 50 μ, on anterior ridge, 60 μ.

Sta. 4691.

HETERODINIUM ELONGATUM, sp. nov.

A small species of elongated form, coarse reticulations and small, close set antapical horns, somewhat resembling *H. hindmarchi* Murray and Whitting (1899), pl. 29, fig. 1, but relatively longer and with smaller, sharper, closer set antapical horns. Body elongated, its length twice the transdiameter in girdle. Epitheca slightly exceeds hypotheca, conical, with obliquely truncate apex but no apical horn, its sides nearly straight. Hypotheca more angular, antapical horns symmetrical, their length a little less than 0.25 and the distance between their tips 0.42 transdiameter in girdle. Girdle descending, displaced 1 girdle width, without overhang; excavated beneath epitheca, posterior list feebly suggested by salient angle. Ventral area contracted anteriorly, spreading abruptly into shovel-shaped area, terminating at post margin which is denticulate. Surface coarsely reticulate with large, irregular polygons, sutures marked by ridges.

Length, 68 μ; transdiameter, in girdle, 35 μ, on anterior ridge, 44 μ.

Sta. 4732.

HETERODINIUM LAEVE, sp. nov.

A large, smooth species with oblique girdle, dorso-ventrally flattened body, low epitheca, with unequal, asymmetrical antapical horns curved to the left and ventrally, somewhat resembling *H. inequale* Kofoid (1906), pl. 18, figs. 9, 10, but differing in greater asymmetry, and longer more curved antapical horns. Length, to middle of antapical margin, 1.18 transdiameters. Epitheca low, its middorsal altitude 0.32, and midventral 0.27 transdiameter, its anterior outline nearly semicircular, apical area to the right, ventral pore swung far to the left. Girdle plane oblique, passing from dorso-anterior obliquely posteriorly to the ventral face. Hypotheca scarcely contracted to the horns, but slightly excavated ventrally. Antapical horns wide-set, long, tapering, both curved to the left and ventrally, with points slightly incurved, the left about twice the length of the right which may be as long as 0.4 transdiameter. Girdle scarcely displaced, with low anterior ridge and no posterior one. Ventral area straight, very narrow, less than 0.5 girdle width across and 0.28 transdiameter long. Surface with few scattered pores in lines along sutures.

Length, 155 μ; transdiameter, 92 μ.

Sta. 4739.

Heterodinium lineatum, sp. nov.

A bizarre form with elongated body and very large pores curiously elongated in antero-posterior direction. Body ellipsoidal, its length 1.8 transdiameters measured in the girdle. Girdle section circular. Epitheca equals hypotheca, with convex, rounded sides and scarcely elevated apex. Hypotheca more angular, longer on left side. Girdle median, descending, displaced less than its width, posterior ridge deficient especially distally. Anterior ridge heavy, salient. Ventral area expanding distally into a large pentagonal plate. Ventral pore half way between apex and girdle, reniform, to right of bent midventral line. This species is peculiar in that the anterior intercalary plate 1^a of the left shoulder is pushed forward to a minute contact with the apical region and might thus be called an apical plate, in which series it would seem to have a normal position. In all other particulars the species conforms to well known Heterodinium characters and it therefore seems best to retain it as an aberrant species of the genus. Sutures marked by heavy ridges (in old thecae), pores in subregular horizontal rows, elongated to about twice their width. Low lists on lateral apical sutures, lists about antapical plate with spinules at nodes.

Length, 60 μ; transdiameter, in the girdle, 33 μ, on anterior ridge, 40 μ.

Sta. 4701.

Heterodinium minutum, sp. nov.

A minute species of subspheroidal form, premedian, displaced, overhanging girdle, two acicular antapical spines and smooth porulate surface. Body subspheroidal, pot-shaped. Length equalling transdiameter on anterior girdle ridge and on greater expansion of hypotheca. Epitheca less than hypotheca, only 0.4 transdiameter in girdle in height, low dome-shaped, apex not protruding save by its bounding ridge. Hypotheca with globular form up to girdle but with equatorial expansion 0.33 of transdiameter in girdle behind anterior girdle ridge. Girdle descending, displaced about 1.5 girdle widths, with ends overhanging in midventral region 1 girdle width, distal end slanted posteriorly on ventral face. Anterior ridge salient, shelf-like; posterior wholly deficient throughout, its position suggested by a line of pores. Ventral area occluded between girdle ends, sigmoid, fan-shaped toward postmargin where it bears two symmetrically placed, ventro-posteriorly projecting acicular spines, a girdle width in length. Another spine and fin guard the left margin of the area. Surface wholly smooth, except for faint reticulations in girdle. Distribution of pores, which are separated by groups of pore-free intercalary bands, suggests the plate arrangement. Anterior intercalary 1^a on left shoulder marked by but a single pore.

Length, 40 μ; transdiameter, in girdle, 35 μ, on anterior ridge, 40 μ.

Sta. 4697.

HETERODINIUM SPINIFERUM, sp. nov.

With the general form of *Peridinium fatulipes* Kofoid. Length 1.6 transdiameters in girdle. Epitheca subconical, with tapering apical horn and angled right shoulder, exceeding hypotheca which has two spreading, attenuate, subulate antapical horns, 0.42 transdiameter in girdle in length. Girdle slightly descending, displaced only 0.25 girdle width, its anterior ridge projecting, shelf-like, the posterior almost wholly deficient. Ventral area spreading, fan-shaped. Ventral pore nearly midway between truncate apex and girdle, at anterior end of elongated, pointed, smooth median area. Surface coarsely and irregularly reticulate, postmargin denticulate.

Length, 80 μ; transdiameter, in girdle, 50 μ, on anterior list, 60 μ.

Sta. 4695.

CENTRODINIUM EXPANSUM, sp. nov.

A large species resembling *C. elongatum* but differing in its greatly expanded girdle, and relatively shorter and less twisted antapical horn. Body elongated, laterally compressed, with blunt apex and elongated asymmetrical antapex. Length 2.85 transdiameters. Girdle section elliptical, major axis dorsoventral 1.12 transdiameters in length. Epitheca, in dorsal view, less than hypotheca, tapering, conical, deflected to the left, with apex unevenly truncated and inclined to the left, widely flaring at the girdle, its altitude 1.2 transdiameters. In lateral view the epitheca resembles that of *C. elongatum*, but is a little higher, fuller along dorsal margin, and with a more rounded apex. Hypotheca in lateral view similar to that of *C. elongatum* but with shorter horn. Its total length 1.3, length of horn 0.7 transdiameters. Horn twisted 90°, curved to dorsal side with a claw-like tip concave on the right face. Girdle premedian, descending, displaced one girdle width, deeply impressed, with stout salient ridges. Fins upon either side of the elongated ventral area. Surface smooth, sparingly porulate.

Length, 107 μ; transdiameter, 41 μ; dorso-ventral diameter, 46 μ.

Sta. 4711.

CENTRODINIUM POROLOSA, sp. nov.

An elongated, abundantly porulate species of small size, with little distal asymmetry, approaching Murrayella in some respects. Body elongated, laterally compressed, with blunt, squarish apex and pointed curved antapex. Length 3.3 transdiameters. Girdle section elliptical with longer axis dorso-ventral. Epitheca less than hypotheca, its length 1.45 transdiameters, conical with truncate apex in ventral view, asymmetrical in lateral view, with apex deflected ventrally. Apex bluntly rounded, 1 girdle width in dorso-ventral and 0.8 in transverse diameter. Hypotheca tapering, asymmetrically conical in both lateral and ventral view, the acute antapex slightly deflected ventrally and to the left. Girdle premedian, displaced 0.45 girdle width, narrowed a little distally, not deeply impressed, with heavy marginal ridge but no lists. Ventral area tapering, less than a girdle width across, extending 5 girdle widths beyond girdle. Surface abundantly porulate with coarse pores, with interspersed areoles. Faint lines along sutures.

Length, 70 μ; transdiameter, 20 μ; dorso-ventral diameter, 23 μ.

Sta. 4729.

OXYTOXUM BREVE, sp. nov.

A minute species of the *O. sphaeroideum* group somewhat resembling Stein's fig. 13, (1883), pl. 5. It differs from it, however, in proportions, and in absence of any trough-like depression in the girdle region. Body broadly ovoidal with projecting epitheca and acute apices. Length 1.4 times greatest transdiameter which is located some distance behind the girdle. Epitheca a minute pointed dome, 0.4 greatest transdiameter in greatest altitude, and 0.5 in greatest basal transdiameter. Hypotheca globular, with pointed antapex, its transdiameter at posterior margin of girdle 0.8 of greatest transdiameter which is 0.57 of total length from apex. Girdle descending, narrowing distally to 0.8 its initial width, very slightly displaced, not impressed or marked in any way by ridges or lists, merely the sloping shoulder of girdle plates whose vertical extent nearly equals that of the superposed but smaller epitheca. Ventral area reduced to a minute notch in hypotheca. Surface smooth.

Length, 20 μ; transdiameter, greatest, 14 μ, at posterior edge of girdle, 11 μ.

Sta. 4733.

OXYTOXUM CURVATUM (Kofoid).

Described by Kofoid (1907), pl. 1, figs. 1, 2, as *Prorocentrum curvatum*. An analysis of its plates shows that it is a peculiar Oxytoxum with its epitheca reduced to a mere terminal button and the girdle to a surrounding shelf, without any anterior list or rib. The flagellar pore and ventral area which is very small, are on the concave face. The ventral area is scarcely deeper than the width of the small apex.

OXYTOXUM RECURVUM, sp. nov.

A medium sized species resembling *O. cristatum* Kofoid (1907), pl. 10, fig. 64, but with long, spinulate apex curved to the left and dorsally, and a fuller hypotheca. Body irregularly and asymmetrically biconical, girdle 0.46 of total length from apex. Length 0.48 transdiameter. Epitheca a low cone whose completed altitude would be 0.5 transdiameter, with a somewhat abruptly continued apex in the form of an elongated, tapering, curved, or even recurved horn, deflected to the left and dorsally, its length attaining in some cases 0.5 transdiameter. Hypotheca 1 transdiameter in altitude, its dorsal outline straight, the laterals and ventral convex, contracted dorsally to a stout, acute antapical horn, 1.4 girdle widths in length. Girdle descending, displaced 1 girdle width. Ventral area very short. Hypotheca ribbed.

Length, 75 μ; transdiameter, 40 μ.

Sta. 4724.

OXYTOXUM ROBUSTUM, sp. nov.

A stout species of medium size allied to *O. compressum* Kofoid but differing from it in absence of lateral compression, and in higher epitheca. Body nearly biconical in ventral view. Length 1.6 transdiameter. Girdle section circular. Epitheca 0.5 to 0.75 altitude of hypotheca, 0.67 transdiameter in altitude, with subconical outline in lateral view, and with concave sides, rounded apex and flaring girdle in ventral view. Hypotheca conical with acute apex curved ventrally, its total ventral altitude 1 transdiameter. Antapical spine scarcely differentiated. Girdle descending, displaced 1 girdle width, its proximal end excavating a rounded pit in margin of epitheca, deeply impressed, without lists. Ventral area 1 girdle width across and 3.5 in total length. Sutures marked by single ribs on hypotheca and by smooth intercalary bands with bounding ribs on main sutures of epitheca. Girdle ribbed, surface of plates finely and regularly reticulate.

Length, 97 μ; transdiameter, 60 μ.

Sta. 4679.

PHALACROMA CIRCUMCINCTA, sp. nov.

Resembling *P. vastum*, but differing in greater elongation of body, position of girdle, and surface markings. Length 1.36 dorso-ventral diameters. Body asymmetrically elliptical in lateral outline which the girdle scarcely modifies. Girdle 0.42 to 0.44 of total length from apex. Girdle lists horizontal, low, hyaline, without ribs, less than girdle width in height. Low sagittal fin on both epitheca and hypotheca, incomplete dorsally. Ventral fins low, 1 to 1.5 girdle widths in height, sometimes reticulated. Surface minutely and closely pitted by somewhat irregular pits, about 35 across the side at girdle, larger next to girdle.

Length, excluding fins, 88 μ; total, 96 μ; dorso-ventral diameter, excluding fins, 70 μ, total 90 μ.

Sta. 4671.

PHALACROMA FAVUS, sp. nov.

A medium sized species somewhat resembling *P. mitra* Schütt but differing from it in having the body contracted dorsally as well as ventrally into a stout antapical horn. Length 1.2 dorso-ventral diameters at girdle. Antapical horn 0.25 total length and nearly 2 girdle widths across. Cuneate in dorsal view. Epitheca a low dome. Dorso-ventral diameter at anterior collar less (dorsally) than at posterior. Girdle lists at 40°, wider than girdle, regularly and closely ribbed. No sagittal fin on anterior and dorsal margins. Ventral fin regularly and heavily ribbed with incomplete riblets. Fission spine club-shaped, two girdle widths in length, ventral fin decurrent behind it. Surface coarsely and regularly covered with honeycomb mesh or coarse pits, 24 on the face at the girdle, spinulate near sagittal suture.

Length, 77 μ; dorso-ventral diameter, 62 μ; greatest transverse diameter, excluding fins, 50 μ.

Sta. 4737.

PHALACROMA FIMBRIATA, sp. nov.

A very large species with biconical (in dorsal view) body, with high epitheca, wide ribbon-like sagittal fins and very coarsely reticulated body. In dorsal view the body is biconical with apices truncated at suture area. In lateral view the body has rounded ends and flaring girdle. Epitheca very high, its altitude 0.5 dorso-ventral diameter (excluding fins), apex broadly rounded, somewhat nearer ventral than dorsal surface. Hypotheca longer, 0.85 dorso-ventral diameter at girdle (excluding fins), antapex inclined ventrally, broadly rounded. Girdle 0.42 of total length from apex (excluding fins). Ribbed sagittal fins completely encircling the body on either side of suture, higher on right side and posteriorly where it is 2 girdle widths across, and laterally reflexed. Girdle with wide, horizontal, ribbed lists. Surface coarsely reticulate with large polygons with heavy bounding mesh, 10 behind girdle on right face, polygonal areas minutely porulate.

Length, 130 μ, including fins, 152 μ; dorso-ventral diameter, 80 μ.

Sta. 4613.

PHALACROMA GIGANTEA, sp. nov.

A huge species with delicate theca somewhat resembling *P. striata* Kofoid, but larger, relatively wider at girdle, and with smaller fins. Body shaped somewhat as in *P. striata* but more symmetrical posteriorly. Length 0.87 to 0.99 dorso-ventral diameter at girdle. Transdiameter exceeding (in some specimens measured) dorso-ventral 1.1. Almost spheroidal posteriorly, flaring at the girdle, especially in dorsal region. Epitheca low, conical or dome-shaped. Girdle lists nearly equalling or exceeding girdle width in height, nearly horizontal, hyaline, non-ribbed, or with numerous straight riblets. Ventral fin short, little over a girdle width in height, hyaline, with one secondary spine, fission spine only 2 girdle widths behind girdle. Low sagittal fin, 0.2 girdle width wide, with numerous minute imperfect riblets. Surface simply porulate or with small, irregular, but well defined, polygonal mesh, each opening with central pore.

Length, 150 μ; dorso-ventral diameter 148 μ; transverse, 165 μ.

Sta. 4734.

Phalacroma limbata, sp. nov.

A large species resembling *P. pulchra,* sp. nov. but with girdle over 0.3 of total length from apex. Body almost circular in lateral view. Length 1.06 times dorso-ventral diameter; transdiameter 0.38 total length, greatest at girdle. Outline not interrupted by girdle. Two low fins about a girdle width in height, with numerous incomplete riblets along sagittal suture. Ventral fin 1.75 girdle widths in height. Antapical spine 3 girdle widths long, basally composed of anastomosing mesh. Girdle lists without ribs, less than 1 girdle width in height. Surface pitted in center of lateral faces, areolate peripherally. Pores less numerous than areoles.

Length, excluding fin, 75 μ; total, 100 μ; dorso-ventral diameter, excluding fins, 68 μ, total 89 μ.

Sta. 4667.

Phalacroma porosa, sp. nov.

A small rotund species resembling *P. rotundata* Clap. et Lach., but with epitheca more flattened and very prominent pores. Body subcircular in lateral outline, much flattened anteriorly, and often sac-like posteriorly. Length 1.1 times dorso-ventral diameter, transdiameter (in individual measured) 0.28 dorso-ventral diameter. Epitheca not exceeding 1 girdle width in height. Girdle lists equal, low, less than girdle width in height, hyaline, ribbed near dorsal suture ribs. Ventral fin hyaline, increasing in height from 1 to 2 girdle widths posteriorly, abruptly terminating behind secondary spine which is longer than the double fission spine. No sagittal fins, but well developed widely displaced (in individual examined) bounding ribs in thecal wall. Surface covered centrally on each side with delicate or strong tracery of polygonal mesh, peripherally free from mesh. Pores large and prominent, centrally located in heavier meshes, about 12 under girdle on one face, two rows in girdle, and marginal row along sagittal ridges.

Length, 51 μ; dorso-ventral diameter, 43 μ; transverse, 28 μ.

Sta. 4721.

PHALACROMA PRAETEXTA, sp. nov.

A small species somewhat the shape of *P. vastum* Schütt and *P. circumcincta*, sp. nov. with slightly premedian girdle and Protoceratium-like, coarse reticulations. Body subcircular in lateral view, in dorsal view biconical with broadly rounded ends. Length, 1.13 times dorso-ventral diameter. Transdiameter, in wide individual measured, equalling dorso-ventral. Girdle indents the epitheca, its posterior ridge about equatorial. Girdle lists low, horizontal, ribbed, 0.5 girdle width high. Ventral fins very small, less than girdle width in height, with single weak spine at fission line. Surface heavily reticulate with distinct Protoceratium-like mesh, 15 behind girdle, of somewhat irregular pore-free polygons. Girdle heavily reticulate. Girdle ribs from nodes.

Length 60 μ; dorso-ventral diameter 55 μ; transdiameter, 51 μ.

Sta. 4742.

PHALACROMA PULCHRA, sp. nov.

A variable species with outline in lateral view subsemicircular posteriorly, somewhat flattened anteriorly, the outline scarcely broken by the girdle. Length about equalling greatest dorso-ventral diameter, rarely 1.3, in which case the antapical region is slightly drawn out. Epitheca, measured from base of anterior collar, never over 0.3 of total length and usually much less. Collars low and spreading, without ribs. Posterior spine of ventral fin somewhat exceeding 0.35 of total length of body in length. Posterior spine long, attaining 0.4 of total length. Ventral, posterior, and low dorsal fin sometimes united in continuous sagittal structure, rarely with reticulations or secondary riblets. Surface smooth with regularly spaced pores, 12 across the side, or finely reticulate.

Length, with spines 74 μ, without 51 μ; dorso-ventral diameter 51 μ.

Sta. 4699.

PHALACROMA TURBINEA, sp. nov.

A medium sized, elongated, top-shaped, very coarsely reticulate species resembling remotely *P. reticulata* Kofoid. Remarkable for the large size of the meshes. Body elongated, spreading at girdle. Length 1.86 dorso-ventral diameters. Girdle section (in individual measured) subcircular, transdiameter 1.21 dorso-ventral diameters. Sides in lateral view concave, tapering to rounded antapex 1.5 girdle widths across. Epitheca a low cone, 2 girdle widths high, with rounded apex. Surface non-porulate, with Protoceratium-like mesh of huge dimensions, 5 across face at girdle, 28 on right side of hypotheca, and 11 on right side of epitheca. The sagittal region has a broad, ladder-like series of rectangular meshes, 14 on dorsal and 12 on ventral face, 1 girdle width wide on ventral and 2 to 3 on dorsal face. Low fins with spinules at nodes are found on the straight ribs at the sides of the ladder. Girdle fins spinulate, girdle ribbed. Ventral fins scarcely elevated above general sagittal fin.

Length, 69 μ; dorso-ventral diameter, 36 μ; transverse, 43 μ.

Sta. 4681.

DINOPHYSIS COLLARIS, sp. nov.

A small species of squarish outline and thin body. Length, excluding spines, 1.05 greatest dorso-ventral diameter. Epitheca very wide dorso-ventrally, 0.8 of dorso-ventral diameter of body, apex concave. Ventral outline convex, posterior and dorsal broadly rounded, the latter concave just posterior to girdle. Anterior and posterior collars approaching horizontal position, abundantly (18 on side) ribbed. Ventral, posterior, and dorsal fins connected in complete sagittal fin; dorsal low, with spinules, posterior carried out in two stout spine-like projections with reticulate skeleton, their length about 0.25 of dorso-ventral diameter; the ventral with skeleton of numerous anastomosing ribs, its greatest width posterior, about 0.4 dorso-ventral diameter. Transverse diameter about 0.35 the dorso-ventral. Surface uniformly covered with small, irregular polygons of heavy mesh.

Somewhat resembles *D. triacantha* with duplicated antapical spine.

Length, excluding spines, 58 μ; dorso-ventral diameter, 55 μ.

Sta. 4671.

DIXOPHYSIS EXPULSA, sp. nov.

A small species, in lateral view with broadly rounded, sac-like outline, widening posteriorly, with marked lateral constrictions behind girdle. Length 1.14 times greatest dorso-ventral diameter. Epitheca low, convex anteriorly, its dorso-ventral width 0.57 of dorso-ventral diameter of body. About 0.35 of the length from the apex the sides of the epitheca are impressed by a trough-like constriction which decreases the transverse diameter at that level over ten per cent. Immediately behind this region the bulging sides attain a transdiameter equalling or even exceeding that just behind the posterior collar, as shown clearly in dorsal or ventral view. Collars without ribs, low, at 45°, anterior one 0.78 diameter of posterior. Ventral fin simple, 0.14 of length of body in width, its length 0.66 that of body, without ribs other than the double fission rib. Surface centrally faintly reticulate, with scattered pores centrally located in some of the meshes.

Length, 55 μ; dorso-ventral diameter, 48 μ.

Sta. 4717.

DINOPHYSIS RUGOSA, sp. nov.

A medium sized species of unique form and structure approaching Histioneis in form of anterior collar. Body rotund, pear-shaped, its greatest diameter twice that at base of posterior collar, and located about 0.33 of length (excluding ventral fin only) from posterior end. Anterior collar sessile, but high, funnel-shaped, and flaring more dorsally than elsewhere, with 10–12 ribs on a side and some basal reticulations, its height 0.25 and opening 0.55 of the greatest dorso-ventral diameter of midbody, oblique, sloping to the right and ventrally. Posterior collar low, erect, slightly flaring, heavily and finely reticulated to the very margin, its height about 0.13 and its opening 0.7 of the greatest dorso-ventral diameter. Both right and left ventral fins heavily reticulated the right low, its height 0.08, and its length 0.75 of greatest dorso-ventral diameter. The left fin continued posteriorly beyond the antapex 0.46 of the greatest dorso-ventral diameter, to an acute point. Fission ribs at level of posterior third of body, slanting at 20° from horizontal. Total length of left fin 1.5 and greatest width about 0.25 of the greatest dorso-ventral diameter. Surface finely, deeply, and regularly pitted.

Length, of body 43 μ, total, 74 μ; greatest dorso-ventral diameter, of body, 42 μ, total, 50 μ.

Sta. 4705.

AMPHISOLENIA ASTRAGALUS, sp. nov.

Allied to *A. bidentata* Br. Schröder but with less ventral curvature of the antapical region and a distinctly foot-like antapex. Length forty times greatest dorso-ventral diameter. Well differentiated midbody extending posteriorly one half total length from head. Greatest dorso-ventral diameter 0.4 of total length from head, about three times same diameter distally. Flagellar pore 0.12 of total length from head. Head subglobular, its dorso-ventral diameter less than that of midbody, and three times that of neck. Furrow ribbed, lists very wide, ribbed. Antapex foot-like with distinct heel and ventral extension, varying in position between horizontal and posterior deflection of 45°, armed distally with two short, stout, terminal spines. The antapical region is curved a little to the left.

Length 650 μ; transdiameter, 16 μ.

Sta. 4713.

AMPHISOLENIA QUADRICAUDA, sp. nov.

Belongs to the *A. thrinax* group but has three ventral branches instead of two (*A. thrinax* Schütt) or four (*A. quinquecauda* Kofoid). Body expanded into fusiform midbody about 0.2 of the total length in length, its greatest dorso-ventral diameter located at 0.25 of total length from the head, and five times that of same diameter distally. Branches, seen in lateral view, 0.33, 0.25 and 0.18 of total length in length. Axis straight in direct lateral view. Flagellar pore 0.09 of total length from head. Head thin, flat, its length equalling greatest width of midbody, and five times that of neck. Fins wide, ribbed. Antapical region curved to left and ventrally, with curved foot-like antapex bearing stout spine at heel and two distally.

Length, 790 μ; dorso-ventral diameter, 45 μ.

Sta. 4695.

Amphisolenia truncata, sp. nov.

Body in lateral view rectilinear. Length forty times greatest dorso-ventral diameter. Slenderly fusiform, greatest dorso-ventral diameter one third of total length from head, about twice dorso-ventral diameter of antapex, diminishing very gradually in either direction. Flagellar pore removed from apex 0.11 of total length. Head thin, flat, elevated 40° from horizontal, furrow sparingly and coarsely ribbed, lists hyaline, without ribs. Antapex in lateral view rectilinear and squarely truncate, without spines, lists, enlargement, or asymmetry.

Length, 640 μ; dorso-ventral diameter, 16 μ.

Sta. 4733.

Histioneis diomedeae, sp. nov.

Belongs to the *para* group, with stout, posteriorly curved extension of the midbody at base of anterior collar. Most resembles *H. reticulata* Kofoid (1907), pl. 15, fig. 95, but differs from it in being much larger. The measurements given (1907, p. 205) for this species should read, length, 57 μ; dorso-ventral diameter (total) 42 μ. It has also an entirely different outline in dorsal view. In *H. reticulata* the midbody has nearly a semicircular posterior outline; in *H. diomedeae* the body is laterally contracted giving to the antapex concave sides and a blunt prolongation, in the dorsal view. In *H. reticulata* the midbody is abruptly angled at the junction of the posterior collar and in lateral view this line forms a sweeping curve. In *H. diomedeae* the sides, in dorsal view, slope regularly at an angle of 45° and the line of junction in lateral view shows a median elevation. Length of midbody 1.08 its dorso-ventral diameter. Transdiameter 0.7 dorso-ventral, epitheca 0.52, horn 0.45 dorso-ventral diameter. Anterior collar sessile, 0.78 dorso-ventral diameter of midbody from dorsal to ventral lip, with numerous simple ribs and marginal riblets. Posterior collar almost same diameter as midbody, bagging out slightly along lateral line of attachment, 0.35 dorso-ventral diameter in height, lightly reticulate on dorsal and ventral regions, with dorsal and ventral ribs only. Ventral fin somewhat as in *H. garretti* Kofoid, but its margin with a protruding, bluntly rounded point at the fission ribs, and concave thence to the elongated posterior spine whose length is 0.35 dorso-ventral diameter. The fin is continued beyond this spine on the dorsal face, its surface smooth, or irregularly reticulate, with a coarse, heavy, and (posteriorly) finely areolated mesh. Surface of midbody coarsely and regularly pitted. Phaeosomes spheroidal or ellipsoidal.

Length, of midbody, 54 μ, total, 115 μ; dorso-ventral diameter, of midbody, 48 μ, total 80 μ; transdiameter, 36 μ; phaeosomes, diameter of spheroidal ones 3.5 μ, ellipsoidal, 1 by 2.5 μ.

Sta. 4699.

HISTIONEIS COSTATA, sp. nov.

A small species resembling *H. paulseni* Kofoid (1907), pl. 15, fig. 94, but differing from it in its stalked, rugose, oblique anterior collar, more rotund body, and in the dorsal inclination of its posterior ribs. Body rotund, slightly depressed anteriorly, without dorsal concavity, oblique ventrally at base of inner collar which stands on a very slight eminence. Length of midbody 0.86 dorso-ventral diameter. Anterior collar stout, distinctly stalked, diameter of neck nearly 0.25, of opening 0.91 dorso-ventral diameter of midbody. Apex very oblique, heavily ribbed, with ends of ribs projecting beyond margin, basally reticulate. Posterior collar a trifle wider than midbody, slightly inflated, lower on right side, with simple dorsal, ventral, and horizontal ribs, and low, hyaline distal frill, without other markings. Ventral fin, in individual examined, low, reticulate, fission rib 0.33 dorso-ventral diameter in length, standing at 45° from horizontal, posterior spine 0.6 dorso-ventral diameter in length, directed obliquely dorso-posteriorly. Postmargin of fin approaching horizontal, its whole surface unmarked. Surface of body coarsely and deeply pitted, with scattered pores.

Length, of midbody, 26 μ, total, 67 μ; dorso-ventral diameter, of midbody, 30 μ, total 40 μ.

Sta. 4604.

HISTIONEIS ELONGATA, sp. nov.

Resembles *H. remora* Stein but differs from his figure (1883), pl. 22, fig. 11, decidedly in form of the midbody, and in details of collars and fins. Midbody elongated in postero-dorsal direction, its longer axis deflected posteriorly about 40° from the horizontal, this axis 1.45 times the one at right angles to it. Scarcely concave on antero-dorsal surface, slightly wider dorsally. Anterior collar rises from rounded eminence, distinctly stalked, length of stalk 0.37 of longer axis of midbody. Apex of funnel very asymmetrically sloped to right and ventrally, distally ribbed, its opening 0.83 of longer axis of midbody. Posterior collar as in *H. remora* but with distal hyaline frill and greater asymmetry of horizontal bar. Ventral fin greatly elongated, ribbed on both margins, its length, from lip of posterior collar, 3.35 times longer axis, its greatest width at level of postmargin of midbody 0.8 of longer axis. Fission ribs 0.5 of longer axis in length, at 40° from horizontal. Fin with distal, transverse lattice between marginal ribs. Phaeosomes very large, spheroidal and minute ellipsoidal.

Length, of longer axis, 26 μ, total antero-posterior of midbody, 26 μ, of whole organism 115 μ; greatest dorso-ventral extent 38 μ; phaeosomes, spheroidal, 5 μ, ellipsoidal, 0.5 by 1.2 μ.

Sta. 4722.

Histioneis hippoperoides, sp. nov.

Resembling *H. reginella,* sp. nov. but with larger midbody, lateral pouches less developed, not reticulated distally, and anterior collar not widely dilated distally. Midbody enlarged postero-dorsally, to twice its antero-posterior thickness ventrally, deeply concaved in the middle, the dorsal hump slightly higher than the ventral. Collars and fins much as in *H. gubernans* Schütt (1895), pl. 5, fig. 23, except that they are larger and more reticulated and the inner collar tapers gradually to a small oblique opening only 2.2 its diameter at midbody, with very little distal flare. The outer collar has lateral extensions (saddle bags) between the horizontal bar and the midbody, the total transdiameter through them being 1.5 transdiameters of the midbody. This collar is covered with a coarse network beyond the horizontal bars, in which a second distal encircling bar is irregularly outlined. The ventral fin extends postero-ventrally, the fission ribs and the posterior rib being subparallel and at 30° and 40° respectively from the horizontal. It bears a marginal band of elongated reticulations and coarser inner network. The ventro-posterior spine bears a transverse fin as in *H. dolon* Murr. and Whitt., somewhat wider than the midbody.

Length, antero-posterior, of midbody, 30 μ, total, 90 μ; dorso-ventral diameter, of midbody, 37 μ, total, 68 μ.

Sta. 4590.

Histioneis hyalina, sp. nov.

A small species of simple structure resembling the less developed forms of *H. cymbalaria* Stein, but much smaller and with midbody of different shape. Midbody pyriform with long axis horizontal, but slightly concave anteriorly and enlarged dorsally, its dorso-ventral diameter 1.8 times its greatest antero-posterior one. No elevation at base of inner collar. Collars as in simplest form of *H. cymbalaria* as figured by Stein (1883), pl. 22, fig. 10, complete hyaline extension beyond horizontal ribs, and with a single bifurcated vertical spine in addition to the dorsal and ventral ones. Inner collar with dorsal flare, reticulate distally. Ventral and posterior fins as in *H. cymbalaria* except that the dorsal spine at the fission plane is curved without bifurcation to junction with the posterior one. Fin to dorsal side of posterior spine curved anteriorly. Phaeosomes spheroidal.

Length, antero-posterior, of body, 12 μ, total, 53 μ; dorso-ventral diameter of midbody, 22 μ, including fin, 25 μ; phaeosomes, 1 μ.

Sta. 4720.

HISTIONEIS INCLINATA, sp. nov.

A minute species of simple structure slightly resembling *H. crateriformis* Stein, but differing from his (1883), pl. 22, figs. 5 and 6, in shorter and less antero-dorsal concavity on midbody, and in details of fin and collar structure. Body subcircular, slightly concave antero-dorsally, epitheca considerably elevated at base of anterior collar. Length and dorso-ventral diameter equal. Antero-dorsal concavity less than 0.5 dorso-ventral diameter. Anterior collar 0.35 dorso-ventral diameter in height, its apex very oblique with few heavy longitudinal ribs. Posterior collar 0.5 dorso-ventral diameter in height with dorsal and ventral sagittal ribs and simple convex transverse bars with distal hyaline margin. Ventral and postero-ventral fins 0.35 dorso-ventral diameter in height, terminating in broadly rounded lobe anterior to antapex. Surface of midbody with fine regular mesh in central part of face, smooth peripherally, about 12 prominent pores on right face. Phaeosomes spheroidal.

Length, of midbody, 17 μ; total, 29 μ; dorso-ventral diameter of midbody, 13 μ, total, 18 μ.

Sta. 4720.

HISTIONEIS INORNATA, sp. nov.

A very minute, unadorned species resembling *H. inclinata* but with different proportions of body and fins, unlike any previously described species. Body rotund, flattened anteriorly, antero-dorsal concavity slight, nearly horizontal, its length 0.55 of dorso-ventral diameter. Flagellar pore well forward on antero-ventral curve. Length 0.8 dorso-ventral diameter. Inner collar on slight eminence, its length 1.05 dorso-ventral diameters, neck very long and slender, opening oblique, 0.5 dorso-ventral diameter. Posterior collar very large, its opening 1.22 dorso-ventral diameters, inflated, with simple dorsal, ventral and horizontal ribs and very low hyaline frill anterior to horizontal bars. Ventral fin 1.5 dorso-ventral diameters in length and about 0.35 in height, rounded and recurved posteriorly with stout ventral spine. Fission ribs 0.33 dorso-ventral diameter in length. Fins and body absolutely smooth and hyaline. A single row of pores at base of posterior collar, 10 on right face.

Length, of midbody, 15 μ, total, 33 μ; dorso-ventral diameter, of midbody, 16 μ, total, 18 μ.

Sta. 4720.

HISTIONEIS KARSTENI, sp. nov.

A small species resembling *H. para* Murr. and Whitt. (1899), pl. 32, fig. 4, but much smaller, with narrower, more ventrally located, broadly rounded apical projection, smaller anterior, and non-ribbed posterior collar, and greater dorsal and posterior development of the sagittal fin. Body very rotund, with bluntly and symmetrically rounded anterior projection on epitheca, 0.3 dorso-ventral diameter in height and of the same width. Length 1.1 dorso-ventral diameters. Anterior collar sessile, with 7 heavy ribs, its height about 0.25, and opening 0.82 dorso-ventral diameter. Posterior collar of same diameter as midbody, its height dorsally 0.55 dorso-ventral diameter, with dorsal and ventral vertical ribs but no other markings. Ventral fin low, heavily reticulate, fission ribs 0.25 dorso-ventral diameter in length, slanting at 45° from horizontal. Posterior fin with median posterior spine 0.66 dorso-ventral diameter in length. Fin terminating acutely, with arched postero-ventral and sigmoid dorsal margins, faintly reticulated on both sides of spine and extending dorsally at base beyond spine 0.27 dorso-ventral diameter. Surface of midbody coarsely and deeply reticulated, 15 meshes behind girdle. Scattered pores.

Length, of midbody, 28 μ, total, 56 μ; dorso-ventral diameter, of midbody, 26 μ, total, 30 μ.

Sta. 4619.

HISTIONEIS PANDA, sp. nov.

A medium sized species resembling *H. navicula* Kofoid, but smaller, with more concave midbody, smaller inner collar, and laterally expanded posterior collar. Body greatly elongated dorsally, with deeply concaved anterior and convex posterior surfaces, the depth of the concavity equalling the antero-posterior thickness of the middle of the body. Body somewhat expanded dorsally. Distance between dorsal and ventral ends 4 times thickness of middle and 2 times its antero-posterior extent. Anterior collar elongated, slender, its height equalling, and apex 0.4 of dorso-ventral extent of midbody. The apex is very oblique, notched on left ventral margin. Posterior collar also with oblique, but contracted opening, about 0.5 of dorso-ventral extent of midbody, expanding dorsally. On the lateral faces spreading horizontally nearly 0.33 of dorso-ventral extent of midbody in saddle-bag fashion. Dorsal ribs low, horizontal bars, sinuous, sagged posteriorly. Both collars faintly reticulate with polygonal mesh antero-dorsally. Ventral fin very low, its ventral margin vertical, straight. Fission ribs directed posteriorly, 0.33 dorso-ventral extent of midbody in length, posterior member continuous by marginal arch with short posterior spine, the arch pinnate. The fin extends posteriorly 0.55 dorso-ventral extent of midbody, and its dorsal frill is ventrally protruded as in *H. pulchra* Kofoid. Surface smooth, a double row of pores along junction of posterior collar.

Length, greatest antero-posterior extent of midbody, 20 μ, total 80 μ; dorso-ventral extent of midbody, 41 μ, total, 42 μ.

Sta. 4724.

HISTIONEIS REGINELLA, sp. nov.

Most resembles *H. gubernans* Schütt, but differs from it in its relatively larger, more rotund midbody, and greatly sacculated posterior collar. The body is broadly and symmetrically rounded posteriorly in lateral view, with flattened anterior margin, slightly elevated at base of inner collar. In dorsal view the body is contracted anteriorly. The collars and fins are superficially as represented by Schütt (1895), pl. 5, fig. 23, with a number of differences in details. The inner collar is not so wide distally, is coarsely reticulate within the distal zone of radial ribs. The posterior collar is considerably larger, sparingly ribbed distally, and bears on each side, well toward the ventral face, a pendant sac-like expansion, over 0.75 of the dorso-ventral diameter of the midbody in length. The apices of these sacs are reticulated. The ventral and postero-ventral fins are similar to those of *H. gubernans* except that both dorsal and ventral margins are curled to the right. Phaeosomes ellipsoidal.

Length, antero-posterior of midbody, 23 μ, total, 55 μ; dorso-ventral diameter of midbody, 19 μ, total, 33 μ. Phaeosomes, 2.5 μ.

Sta. 4681.

HISTIONEIS ROTUNDATA, sp. nov.

A minute species with midbody of *H. remora* Stein and collars and fins resembling those of *H. para* Murr. and Whitt., but differing from the species figured by Stein (1883), pl. 22, fig. 11, in more rotund midbody, shorter and wider postero-ventral fin, shorter anterior collar, and longitudinally ribbed posterior collar. From Murray and Whitting's (1899), pl. 32, fig. 4, species it differs in the narrower neck of midbody, slenderer stalk of anterior collar, and wider ventral fins. Body almost spheroidal, with mound-like elevation at base of anterior collar. Anterior collar low, 0.5 dorso-ventral diameter of midbody in height, its apical diameter about equal to that of midbody, with a few short ribs. Posterior collar nearly vertical, 0.3 to 0.5 dorso-ventral diameter in height, with 5 aciculate ribs on the side. Ventral fin 2 dorso-ventral diameters from lip of posterior collar to antapical end, swelling ventrally posterior to fission spines, tapering to blunt antapex, with stout bowed posterior rib, 0.8 dorso-ventral diameter in length. Fin faintly reticulate basally. Surface minutely areolate, with 11 pores on right face.

Length, of midbody, 17 μ, total, 38 μ; dorso-ventral diameter, of midbody, 13 μ, total, 16 μ; transdiameter, 13 μ.

Sta. 4720.

HISTIONEIS STRIATA, sp. nov.

Resembling *H. gubernans* Schütt but differing from his (1895), pl. 5, fig. 23, in its smaller size, much smaller collars, and proportions of ventral fin. Midbody rotund, more symmetrical than in *H. gubernans*, postero-dorsal concavity well developed, horizontal, its length 0.55 dorso-ventral diameter. Length 0.92 dorso-ventral diameter. Anterior collar elongated, its length 1.2 and opening 0.3 dorso-ventral diameters, neck stout, opening oblique, with several distal riblets. Posterior collar not so wide as midbody, its height 0.9 to 1 and its opening 0.85 transdiameter, constricted dorsally at level of arched horizontal bars, its distal frill high, with about 6 vertical distal riblets on each face. Ventral fin as in *H. gubernans* and *H. reginella*. Marginal rib with distal frill and scattered distal riblets. Postero-ventral spine horizontal, distally recurved, the fin upon its dorso-posterior margin recurved ventrally as in *H. reginella*. Surface smooth, 7 pores behind posterior collar and 3 midway below. Phaeosomes ellipsoidal. The distal riblets of the collars and fins give the organism a striate appearance.

Length, of midbody, 15 μ, total, 42 μ; dorso-ventral diameter, of midbody, 16 μ, total, 31 μ; phaeosomes, 1 by 1.5 μ.

Sta. 4720.

ORNITHOCERCUS FORMOSUS, sp. nov.

A large and handsome form not closely resembling any known species. General outline of whole in lateral view rectangular with concave postmargin. Body subcircular in lateral view, fuller in postero-dorsal region. Squarish toward the girdle, its length about equal to its dorso-ventral diameter. Transdiameter 0.7 dorso-ventral. Anterior collar 0.83 dorso-ventral diameter, with simple ribs mostly complete, with reticulate mesh near base. Posterior collar basally expanded, with stouter ribs and heavy reticulations reaching margin in dorsal and ventral quadrants. Ventral fin running straight posteriorly from lip of posterior collar, with coarse irregular reticular mesh filling the fin and also the minor right fin which is short and rectangular in form. The postmargin of the sagittal fin is crescentic with feebly developed marginal rib, nearly submerged radial riblets and a very stout dorso-posterior spine in the dorsal lobe of the crescent with fine mesh on its dorsal wing. Dorsal margin straight. Surface regularly and deeply pitted with porulose pits.

Length, of body, 40 μ, total, 90 μ; dorso-ventral diameter, of body, 40 μ, total 50 to 63 μ.

Sta. 4697.

ORNITHOCERCUS ORBICULATUS, sp. nov.

A large species resembling *O. serratus* Kofoid, but with entire, orbicular, sagittal fin. Body subcircular in lateral view, obliquely flattened anteriorly and excavated antero-dorsally. Its length a trifle less than its greatest dorso-ventral diameter. Anterior and posterior collars subequal in dorso-ventral diameter. Anterior with simple, straight major ribs and minute peripheral riblets, or with sparse, irregularly curved and anastomosing ribs and reticulations. Posterior with stouter simple ribs. Form and proportions about as in *O. serratus* Kofoid. Sagittal fin complete, with straight dorsal margin and circular outline to ventral lip of posterior collar, with seven or eight major simple, or basally bifurcated ribs breaking distally into feebly developed marginal reticulations. Surface coarsely reticulate, each polygon or pit with pore, 15 behind girdle.

Length, of body, 65 μ, total, 115 μ; dorso-ventral diameter, of body, 70 μ, total, 115 μ.

Possibly a phase in thecal reconstruction.

Sta. 4617.

BERGHIELLA, gen. nov.

With the form of a spheroidal *Gonyaulax* with very abruptly differentiated low cylindrical apical horn with truncate apex. Girdle with hyaline lists, descending, displaced less than a girdle width, not impressed. Ventral area not delimited posteriorly. Absolutely no trace of subdivision of theca into plates or regions. Type species *B. perplexa*.

BERGHIELLA PERPLEXA, sp. nov.

Body, excluding apical horn, a short ellipsoid with vertical axis (excluding horn) 1.12 transdiameters, with horn 1.25. Girdle section circular. Apical horn low, stout, apex squarely truncated, its height 0.16, its diameter at base 0.24, and at apex 0.19 transdiameters. Girdle equatorial, posterior list of proximal end half way between base of apical horn and antapex, the epitheca thus slightly exceeds hypotheca; descending, displaced distally 0.33 girdle width, not impressed, its sides formed by thin hyaline structureless lists, 0.6 girdle width in height. A narrow crease runs forward from the junction of the girdle-ends nearly to base of apical horn. Ventral area suggested by short posterior extensions of the posterior list at the two ends of the girdle. A small pore (flagellar pore?) lies in this territory. Surface without trace of sutures, or marked reticulations, minutely and evenly flecked by the faintest suggestion of areoles. A single line of pores anterior to the girdle. Contents highly vacuolated, completely filling the theca. Nucleus elongated, reniform.

Length, 65 μ; transdiameter, 50 μ.

Stage of growth, relationships, and even orientation problematical.

Sta. 4670.

AMPHITHOLUS QUINCUNCIALIS (Kofoid).

Described by oversight as *Amphilothus quincuncialis* in my earlier (1907) paper.

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A NEW SPECIES OF PERIPATUS FROM GRENADA, WITH OBSERVATIONS ON OTHER SPECIES OF THE GENUS.

By Charles T. Brues.

With Two Plates.

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No. 8.— *A new Species of Peripatus from Grenada, with observations on other species of the genus.*[1]

By Charles T. Brues.

It has been suspected for some time that Peripatus must occur upon the Island of Grenada, but so far as I have been able to ascertain no actual published reference to any specimens from there has yet been made. Peripatus was first discovered upon the island of St. Vincent which is only sixty-eight miles from Grenada, and as is well known, dates back to 1825 when Guilding described *Peripatus juliformis* which he believed to be a mollusc. The Grenada species is therefore of peculiar interest from an historical point of view, aside from its value in giving evidence of the faunal relationships of the island.

The opportunity of collecting the species I owe to Dr. Thomas Barbour, who made it possible for me to accompany Dr. G. M. Allen on a trip to the Island of Grenada during August and September, 1910. In addition to searching for reptiles, one of the main objects of the expedition was to obtain, if possible, specimens of Peripatus. During the first two weeks of our stay we collected rather thoroughly over the country about St. Georges which is situated on a beautiful little harbor near the southwestern extremity of the island. Here the hills rise to a height of about 600 feet above sea-level, and in places the environment seems well adapted to such moisture loving animals as Peripatus. Our search was entirely in vain, and none of the native boys who are very keen-eyed and observing, could recall ever having seen anything resembling them. We did not attach very much importance to this, however, for there is a large milliped related to Julus which is very common in damp decaying logs and stumps. This is of the same general size and form as Peripatus and the two would probably be confused under the name "Congeree" which is applied to the milliped.

Towards the center of the island, the hills rise considerably higher, attaining altitudes of over 2000 feet and supporting humid forests that form a typical "Regenwald." In one of these higher localities, surrounding a little lake there is a small forest reserve where the natural character of the vegetation remains practically unchanged. Here the rainfall, approximating 160 inches annually, is much greater and the temperature considerably lower, than in the coastal region. It was in this region, close to the border of the Grand Etang Lake that I unearthed the first specimen of Peripatus. It was concealed within a low, much decayed stump inside which it had evidently been living for some time, as some galleries within the wood left by wood-boring larvae, were smeared with the solidified glutinous secretion of its mucus glands. Entangled in this gummy substance were the chitinous remains of some arthropods upon which the Peripatus had evidently been feeding. Recognizable among these was a black harvestman (phalangiid) which is very commonly seen in decaying stumps.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 44.

During the next several days we made a very thorough search in the vicinity, and Dr. Allen was successful in finding two additional specimens. These were similarly hidden in decaying wood near the surface of the ground, not far from the lake. The species is apparently localized in this small region, for an equally thorough examination of the nearby hills and lower swampy areas brought to light no further examples. It would appear, therefore, that *Peripatus barbouri* is not only rare, but restricted in its distribution to one or probably several small areas among the high hills in the central part of the island.

The following table of the Caribbean species of Peripatus (Péripates caraïbes) is a translation of the one included in Bouvier's recent monograph,[1] with the addition of the Grenada species, and has been introduced for reference in discussing the distribution and relationships of the Antillean species.

1. Transverse dorsal folds numbering 24 to each segment, always very slightly distinct on account of numerous anastomosings and irregularities in the grooves which separate them; accessory papillae rare or absent, primary papillae small and subequal; crural tubercles present on the two praegenital pairs of legs in the male . . . . . Section of *P. jamaicensis*
   Dorsal folds numbering 12 to each segment; separated by continuous grooves except at the level of the legs where some of the grooves usually bifurcate 2
2. Primary papillae on the dorsal surface of the body each with a quadrangular base separated by straight grooves parallel with the axis of the body; accessory papillae ordinarily small and few in number; crural tubercles present on the two praegenital pairs of legs in the male (at least in *P. perrieri*) . . . . Section of *P. torquatus*.

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[1] Bouvier, E. L. Monographie des Onycophores, Ann. Sci. Nat. Zool., 1905–1907, ser. 9, **2**, p. 1–383, 13 pls.; **5**, p. 61–318.

Primary papillae of dorsal surface, each with a more or less rounded base; accessory papillae exhibiting very diverse stages of development . . 3

3. Primary papillae of dorsal surface exhibiting great differences of size at all ages; some very predominant, of a cylindrical type; the others conical, smaller, and generally to the number of three between two large ones; these tubercles separated by rather broad intervals, where the accessory papillae are placed. Crural tubercles usually present on more than two praegenital pairs of legs in the male . . . Section of *P. juliformis.*

Primary papillae of dorsal surface, all belonging to one type; in specimens of medium or large size, these papillae intergrade through all degrees of size, while in small specimens some are clearly preëminent. These papillae are much approximated, but it is not usual to find accessory papillae between them. Crural tubercles present on the two praegenital pairs of legs in the male . . . . Section of *P. edwardsii.*

1st Section of *P. jamaicensis.*

Body slender; legs strongly approximated, at least 35 pairs in the male and at most 43 pairs in the female; frontal organs much clearer than the remainder of the integument . . *P. jamaicensis* Grabh. & Chll.

2nd Section of *P. torquatus.*

1. Primary papillae almost reduced to a basal portion shaped like an abbreviated pyramid with feebly convex summit; the terminal portion of the papilla much reduced or absent, often represented only by a simple apical bristle (soie); accessory papillae very small, not at all numerous and but slightly apparent; creeping pads composed of four bands, with very distinct trace of a fifth 2

Primary papillae with a high, subconical base, and well-developed terminal cylinder; accessory papillae quite distinct 3

2. Primary papillae subequal; 41–42 pairs of legs (perhaps a few less in the male); salivary glands terminating opposite the tenth or eleventh praeanal pair of legs . . . . *P. torquatus* Kennel.

Primary papillae very unequal; 28–32 pairs of legs; salivary glands terminating in the neighborhood of the third praeanal pair of legs. *P. perrieri* Bouvier.

3. 32 pairs of legs in the type female; nephridial tubercle on the fourth and fifth pair of legs free, or attached to the third band of the creeping pad by a narrow petiole; salivary glands terminating near the third praeanal pair of legs . . . . *P. geayi* Bouvier.

27–28 pairs of legs in the female; nephridial tubercles broadly attached to the third band of the creeping pad, or entirely separate; salivary glands terminating opposite the 5th–7th praeanal pair of legs . . . 4

4. Nephridial tubercles broadly attached to the third band of the creeping pad; dorsal lozenge-shaped markings rather indistinct *P. ohausi* Bouvier.
Nephridial tubercles free from the creeping pad; dorsal lozenge-shaped markings very distinct . . . . *P. ohausi* subsp. *guianensis* Evans.

3rd Section of *P. juliformis.*

1. The larger primary papillae of the dorsal surface with a relatively reduced base and enlarged, often spherically dilated, apex; 28–30 pairs of legs in the male and 29–32 pairs in the female 2
The larger primary papillae much more strongly developed toward the base than at the apex 6
2. The smaller primary papillae very much reduced, often to a single one between two large ones, and separated by broad interspaces occupied by very small accessory papillae; crural papillae present on from 6 to 9 praegenital pairs of legs in the male 3
The smaller primary papillae well-developed and usually placed in series of three between two large ones; accessory papillae equally well-developed; crural papillae present on three or four praegenital pairs of legs in the male 4
3. Size large, female from 25–60 mm. in length; dorsal surface with more or less distinct lozenge-shaped markings; accessory papillae numerous *P. sedgwicki* Bouvier.
Size small, unique female 15 mm. in length; color uniform and very dark; accessory papillae less numerous . *P. sedgwicki* subsp. *bavayi* Bouvier.
4. Larger primary papillae distinctly grouped in sinuous longitudinal series; accessory papillae few and of small size *P. juliformis swainsonae* Ckll.
Larger primary papillae irregularly disposed, not forming longitudinal series 5
5. Larger primary papillae sharply preeminent over the smaller ones; accessory papillae very evident . . . . *P. juliformis* Guilding.
Smaller primary papillae notably more developed; accessory papillae becoming vestigial . . . . *P. juliformis danicus* Bouvier.
6. Larger primary papillae with the apex poorly developed and of small dimensions; smaller papillae much reduced and ordinarily disposed singly between two large ones; accessory papillae very small; crural tubercles on two or three praegenital legs in the male; prostates between praeanal legs XII–XVIII; nephridial tubercles of legs IV–V broadly attached to the creeping pads; 29 pairs of legs in the male, and 30–33 in the female . . . . *P. broelemanni* Bouvier.
Larger primary papillae with a terminal cylinder of rather large size; smaller ones well-developed and ordinarily disposed in threes between two large ones, accessory papillae intergrading through all sizes to the smaller primary papillae; crural tubercles present on two praegenital

pairs of legs in the male; prostates between praeanal legs IV–VI; nephridial tubercles of legs IV–V free or feebly attached; 25 pairs of legs in the male and 28–31 pairs in the female 7

7. Nephridial tubercles attached to the third band of the creeping pad by a constricted base; larger primary papillae well separated, by much more than their diameter at the base . . . . . *P. dominicae* Pollard.
Nephridial tubercles free from the creeping pad; larger primary papillae more approximated 8
8. Accessory papillae moderately well-developed and somewhat numerous. *P. dominicae* var. *antiguensis* Bouvier.
Accessory papillae much reduced and less numerous *P. dominicae* var. *juanensis* Bouvier.

Section of *P. edwardsii*.

1. No incomplete segmental folds at the level of the legs; 29 pairs of legs in the male and 31–32 pairs in the female . *P. brasiliensis* Bouvier.
Some of the segmental folds incomplete at the level of each pair of legs . 2
2. Nephridial tubercles of legs IV and V ordinarily lying in an emargination of the fourth band of the creeping pad, but without throwing it out laterally or dividing it into sections; creeping pads broad 3
Nephridial tubercles of legs IV and V free; pushing the fourth band out laterally, or dividing it into sections 8
3. Accessory papillae intergrading in all degrees with the primary papillae which are of extremely varied dimensions 4
Primary papillae forming a series along the ridge of each fold and very distinct from the accessory papillae which are rarely intercalated among them; salivary glands terminating between the third and fourth praeanal pairs of legs 7
4. Accessory papillae very numerous and often disposed in series of two or three between the primary papillae, thus interrupting the continuity of the latter; no lozenge-shaped color markings on the body above . 6
The ridge of each fold is occupied by a series of papillae, some of these primary and of varied sizes, the others accessory; almost always numerous accessory papillae extend upward on the flanks along the sides of the folds; salivary glands terminating between the third and fourth praeanal pairs of legs 5
5. Body with dorsal lozenge-shaped color markings; 27–30 pairs of legs in the male and 29–32 pairs in the female . . *P. trinidadensis* Stuhlmann.
Body entirely without dorsal color markings; 30–31 (usually 31) pairs of legs in the female . . . . *P. barbouri*, sp. nov.
6. Salivary glands terminating between the third and fourth pairs of praeanal legs; nephridial tubercles free or slightly attached; 28–31 pairs of legs in the female . . . . *P. imthurmi* Sclater.

Salivary glands terminating between the seventh and tenth praeanal pairs of legs; nephridial tubercles broadly attached; 28 pairs of legs in the male . . . . *P. evansi* Bouvier.

7. Primary papillae subequal, rarely separated by accessory papillae, the latter being disposed on the flanks of the folds; lozenge-shaped color markings on the body above; 28–29 pairs of legs in the male and 29–32 pairs in the female . . . . *P. edwardsii* Blanch.
Primary papillae of extremely varied dimensions, sometimes separated by accessory papillae; no dorsal lozenge-shaped markings; 28–32 pairs of legs in the female . . . . *P. simoni* Bouvier.
8. Creeping pads of the usual size; nephridial tubercles deeply excavating the fourth band of the creeping pad and dividing it into sections; 26–28 pairs of legs in the male, and 30 in the female. *P. biolleyi* Bouvier.
Creeping pads very narrow; nephridial tubercles pushing out the fourth band of the creeping pad laterally; the latter greatly reduced; 26 pairs of legs in the male, and 29–32 in the female 9
9. Internal mandibular blades with one accessory tooth; primary papillae more nearly equal . . . . *P. nicaraguensis* Bouvier.
Internal mandibular blades usually with two accessory teeth; primary papillae strongly unequal . *P. nicaraguensis* var. *isthmicola* Bouvier.

PERIPATUS BARBOURI, sp. nov.

Plate 1.

Form of body, dimensions. The body is moderately elongate, and slightly flattened, but less noticeably so in the largest specimen. The following table gives the measurements of the three specimens:

	Largest	Type	Smallest
Total length of body............	50 mm.	53 mm.	38 mm.
Greatest width..................	7.3 mm.	5.5 mm.	4.8 mm.

Coloration. So far as the three living specimens are concerned, the color of this species appears to be very constant. The upper side of the body is dark purplish slate-color, almost black, except when seen in sunlight when the velvety texture of the integument causes it to assume a distinctly grayish or glaucous tinge. The region directly along the median dorsal line is sometimes more nearly black, but not in all cases. Aside from this, however, the upper side is entirely without color pattern, and presents no indication of the lozenge-shaped pattern exhibited by some of the related species. On the ventral side the color is much lighter and quite distinctly purplish pink. The legs are intermediate in color between the upper and under sides of the body. Above they are lighter than the dorsal surface of the body, but much darker than their undersides which are in turn very decidedly darker than the underside of the body.

Integument. The dorsal folds are sharply defined and the transverse grooves that separate them are deeply and clearly impressed. Between the furrows, the surface of each fold is regularly but not very strongly convex. Along the median line the number of folds is very uniform, twelve to each body segment, but laterally, particularly halfway to the base of the legs, many of the grooves coalesce. Near the middle body segments, there are on the average about two cases of coalescence to a segment, so that the folds are quite appreciably wider on the half of each side of the body which is next to the insertion of the legs. The dorsal median hyaline line is sharply defined, but is very much more distinct upon every second transverse fold, the alternating folds having only a very slight indication of it, either by reflected or by transmitted light. The hyaline organs (*organes clairs*) are not at all, or very feebly defined.

The primary papillae are confined almost entirely to the ridges of the folds, although they do not form a straight line except in very rare cases. Usually they form an irregular line which is quite clearly distinguishable from the smaller papillae along the slopes of the fold, but exceptionally, some of the larger papillae descend a considerable distance from the ridges. The slopes of the folds are furnished with the smaller papillae, many of which ascend on to the ridges between the largest ones. The large, medium sized and small papillae intergrade completely, so that it is impossible to distinguish between primary and accessory ones. In most cases, however, there are about three, more rarely two or one, smaller papillae between two especially large ones along the ridges of the folds. The papillae are all of approximately the same form, with well-developed conical bases and greatly reduced, scarcely evident cylindroid apices. The hyaline streaks in the integument separating the bases of the papillae are very sharply defined and form an extremely irregular network which encloses areas of all shapes and sizes, most of them plainly polygonal in form.

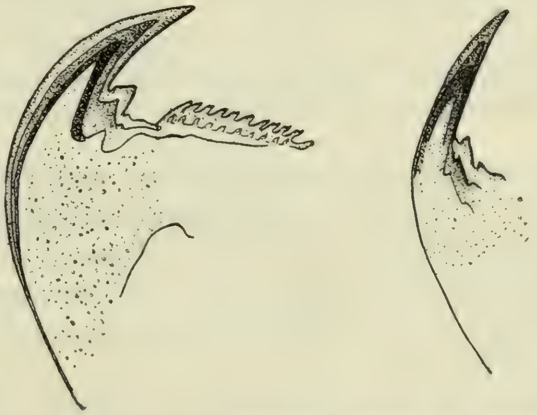


FIG. 1.— *Peripatus barbouri,* sp. nov. Outer blade of mandible showing denticles, and outer portion of inner blade.

Mandibles. The external blade of the mandibles bears two accessory teeth, of which the apical one is well-developed, but the inner one is scarcely half so long and quite inconspicuous. It bears twelve denticles on the single blade upon which I have been able to make an accurate count. The inner blade bears two accessory teeth, of which the basal one is much the smaller, and reduced to less than half the length of the apical one.

Legs. All of the three adult females before me bear 31 pairs of legs, but in a well-developed embryo removed from one adult, there are only 30 pairs. I cannot be positive, but suspect that the embryo is a female. From this it would appear very probable that 31 pairs of legs is the commonest number for females of the species, and that variations above and below this mean will be found as is the case among the other species.

The nephridial tubercles of the fourth and fifth pairs of legs are broadly attached to the third band of the creeping pad, although in some instances the connection is slightly narrower than that shown in figure 2, which is taken from the largest specimen. However, the convex form of the tubercle gives it the appearance at first sight of being separated from the creeping pad, although their continuity is readily to be traced.

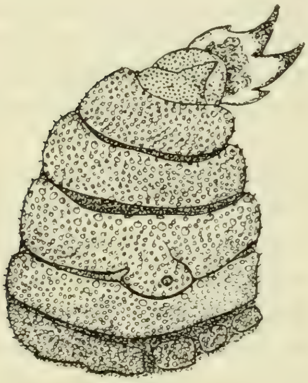


FIG 2.— *Peripatus barbouri*, sp. nov. Fifth leg of female showing position of nephridial tubercle.

The genital opening is exactly between the bases of the penultimate pair of legs.

Anatomy. The position of the ovaries has been determined from the largest specimen, which contained embryos. The ovaries lie approximately between the legs of the sixth praeanal pair, and their ligaments are distinctly separate all the way to the base of the ovaries, although they lie very close together. The salivary glands terminate between the third and fourth praeanal pairs of legs.

Habitat. All three specimens were taken at an altitude of 1800 feet at Grand Etang on the Island of Grenada, British West Indies.

The closest affinities of the Grenada Peripatus are evidently with *P. trinidadensis* from Trinidad, which lies to the southwest of Grenada, its northern coast removed about 90 miles from the southern extremity of the latter. Two species are known to occur in Trinidad, but the second, *P. torquatus* is very different from *P. barbouri* and approaches nearest to *P. jamaicensis* in the large number of legs (41–42 pairs) while *P. barbouri* has only 31 pairs. *Peripatus torquatus* is also very conspicuously banded with yellow just behind the antennae and the color of the dorsal surface is reddish brown. The form and arrangement of the papillae is not at all similar, for in *P. torquatus* there is no gradation between primary and accessory papillae; the latter are very few in number, and the bases of the primary ones are rectangular — not irregularly polygonal as in *P. barbouri.* A remarkable similarity is seen, however, in the bifurcation of two transverse folds on each body segment toward the middle of the dorsum. This occurs in both species in exactly similar fashion.

With *P. trinidadensis* the affinities of the Grenada species are very great, as well as with *P. imthurmi, P. sedgwicki,* and certain forms of *P. dominicae.*

From *P. trinidadensis,* it may be distinguished by the entire absence of dorsal lozenge-shaped color markings, and by the not very prominent transverse tegumentary folds. There appear also to be more very small accessory papillae, although middle sized ones showing all gradations to the primary papillae are always present on the folds, but otherwise the resemblance between the two forms is extremely close. Just as *P. trinidadensis* is more or less intermediate between *P. imthurmi* from Guiana and the West Indian *P. dominicae* with its varieties, *P. barbouri* must be interpolated between *trinidadensis* and *dominicae.* There can be no doubt, however, that the similarity to the former is much greater than to the latter since the gradation between the sizes of tegumentary papillae at once distinguishes it from *P. dominicae,* which falls on this account into a different group in Bouvier's classification. The latter species has fewer legs (29 pairs) on the average also, at least in the typical form, although the variety *antiguensis* may possibly average 30 or 31 pairs.

One is led to believe, therefore, so far as the evidence furnished by the Grenada Peripatus is concerned, that the faunal relationship of Grenada with Trinidad is much closer than with St. Vincent to the north as the latter island supports *Peripatus juliformis,* a form that extends northward with varietal variations as far as St. Thomas and Jamaica, and one which is widely different from *P. barbouri.*

Unfortunately no Peripatus has been, so far, reported from Tobago, which lies to northeast of Trinidad and southeast of Grenada. The genus undoubtedly must be represented there, and one may surmise that forms identical, or at least very close to those on Trinidad will be found as the fauna of Tobago is but little different from that of Trinidad.

From the foregoing it will appear that Grenada probably represents the northern limit of extension of the group so well-developed in the northern coastal region of South America. That these forms may extend still further to one of the Leeward Islands, is possible since Bouvier has described from Guadeloupe a variety *bavayi* which he regards provisionally as belonging to *P. sedgwicki.* This he believes may really represent a distinct species, however, when known from more extensive material. On the north several forms show a close relationship of St. Vincent and Dominica to the more northern islands; thus *P. dominicae* extends in varietal forms from Porto Rico to Antigua and as far south as Dominica, while the varieties of *P. juliformis* extend from Jamaica through St. Thomas to St. Vincent on the south.

PERIPATUS JULIFORMIS GUILD, VAR. SWAINSONAE COCKERELL.

Plate **2**, figs. 1–2.

I have had the opportunity of examining a large series of this Jamaican species collected by Messrs. M. Grabham and Thomas Barbour at Bath, Jamaica, and presented to the Museum of Comparative Zoölogy by Dr. Barbour. There are 114 specimens in all, the majority of them females, but with a good series of males.

These have been examined to ascertain the amount of variation in the number of legs, and the results are tabulated in figure 3a. The number varies from 27 to 35 with 28 pairs as the mode for males and 33 pairs for females, and in both sexes the modal number is far more common than all the other numbers together. Since Bouvier has recorded the number of legs in all the specimens of this species which he has seen, I have added his data in dotted lines, and it will be seen that these follow closely the solid lines representing the present material. In figure 4a I have added the two curves together, and believe that this represents quite closely the actual range of variation, as the sum is based on nearly 200 specimens. It will be seen that there is hardly any overlapping of the male and female polygons, so that the sexes may be almost positively separated by the number of legs, the males having less than 30 and the females over 30.

The color of the present series of specimens is somewhat different from that described by Bouvier for individuals from exactly the same locality in Jamaica, and I suspect that the difference is due to the length of time they have remained in alcohol. Bouvier describes the color as grayish above, sometimes paler and delicately tinged with greenish yellow, or sometimes darker and tending toward dark gray. There is great variation in the shade, but all of the better preserved and unfaded individuals have the dorsal surface very dark gray, almost blackish, with a faint brown-purple cast. Faded specimens pass through various stages of yellowish and purplish gray, becoming very pale and showing to the unaided eye very plainly the dark tips of the primary papillae which are so placed as to form

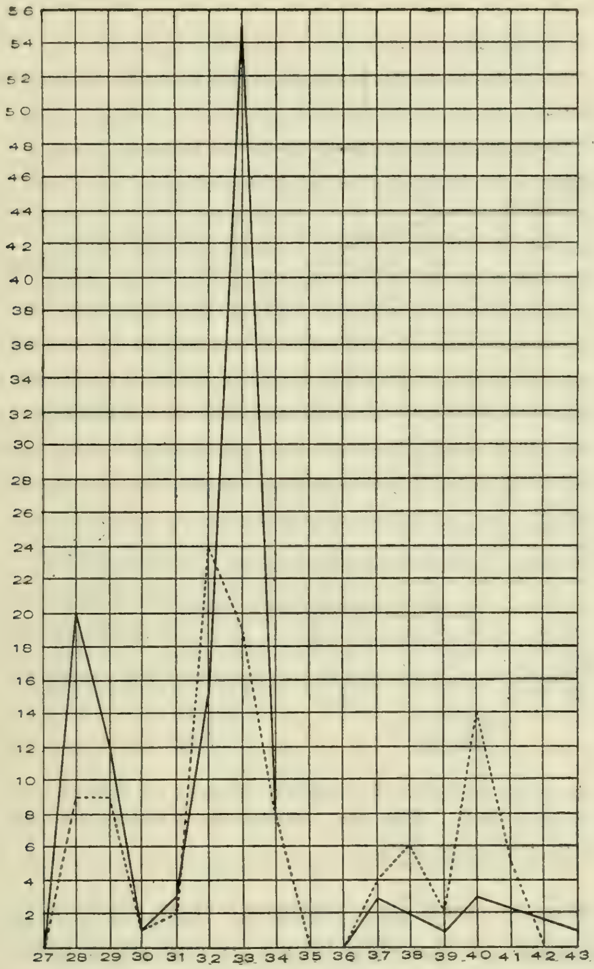


Fig. 3a. Fig. 3b.

FIG. 3a.— *Peripatus juliformis* Guild. var. *swainsonae* Ckll., curve showing variation in number of pairs of legs. Fig. 3b. Same for *Peripatus jamaicensis* Grabh. & Ckll. Solid lines based on present material; dotted line on that examined by Bouvier.

sinuous or discontinuous longitudinal lines along the back (Plate **2**, figs. 1–2). The underside is uniformly paler, with the same slight purplish or pinkish brown tinge seen in much darker shades above.

In the present collection from Bath a number of specimens of *Peripatus jamaicensis* Grabh. and Ckll. are included, taken at the same time from exactly the same territory, showing that the two species regularly occur together. Bouvier has noted the same fact, and Dr. Barbour tells me that in collecting, the species were in no wise segregated although readily distinguished at a glance by the conspicuous white tips to the antennae in some specimens of *jamaicensis*. The latter is very less common than *juliformis*, var. *swainsonae*, the specimens of the two being in the proportion of 114 to 8. Of all specimens seen by Bouvier, the ratio is 72: 31, showing a much less evident preponderance of *juliformis*. There can be no doubt, however, that *juliformis* is by far the more abundant species.

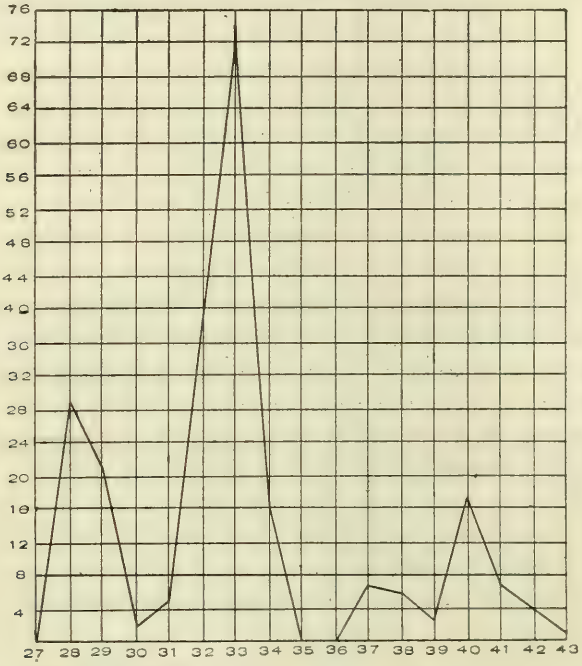


Fig. 4a. Fig. 4b.

FIG. 4a.— Curve showing variation in number of pairs of legs in *Peripatus juliformis* Guild. var. *swainsonae* Ckll. Fig. 4b. Same for *Peripatus jamaicensis* Grabh. & Ckll. Based on all available data.

PERIPATUS JAMAICENSIS GRABHAM AND COCKERELL.

Plate 2, figs. 3–4.

This species is the most sharply distinguished of all the Caribbean Peripati on account of the doubling of the transverse tegumentary folds, which number 24 to a segment in place of 12 as in all other forms (Plate **2**, figs. 3–4). The number of legs is also greater than in any other species except *P. torquatus*, a species occurring in Trinidad.

As previously mentioned it occurs with *P. juliformis*, var. *swainsonae*, but is much rarer. Two mutations, or dimorphic color types have been distinguished, *gossei* Ckll. with the tips of the antennae white, and *bouvieri* Ckll. with the antennae entirely dark colored. Both are represented among the eight specimens I have seen, each type by four individuals. Bouvier, however, records *gossei*, with the tipped antennae as by far the more common form. In all that I have seen there is a curious correlation between the body color and the variegation of the antennae. In the four with tipped antennae, the body is uniformly brownish or purplish gray, almost black while in those with uniformly colored antennae, the body is much paler, almost tan colored, and apparently much faded in the alcoholic specimens, till parts of the body are extremely pale. In these the antennae however, appear not to be faded and are entirely blackish. Such differences between the two forms do not appear to have been noted, and may be accidental, although the exact agreement of four specimens of each kind would make it appear to be quite a constant difference in pigment as affected by alcohol, although not noticeable in living individuals, which are all uniformly dark.

Concerning the distribution of *Peripatus jamaicensis* little is known, as the species has been found so far only in a very restricted area near the eastern extremity of Jamaica. The present specimens are all from Bath, the locality to which most of Bouvier's collected records relate.

A Peripatus from British Honduras.

Hitherto no Peripatus has been recorded from British Honduras, but the Museum of Comparative Zoölogy contains a single specimen obtained by Dr. A. M. Tozzer while in charge of an expedition to Central America in the interest of the Peabody Museum. The specimen was collected by Rev. Father Stanton at Benque Viejo.

Unfortunately the preservation of the specimen is such that it is impossible to determine its affinities. There are thirty pairs of legs which would agree with *P. biolleyi* Bouv., but the integument is so bleached and otherwise altered that I have not been able to discern the structure of the dermal papillae or nephridial tubercles upon which the correct determination must depend.

The body of the specimen is very narrow and elongate, 65 mm. in length, and only 5 mm. broad.

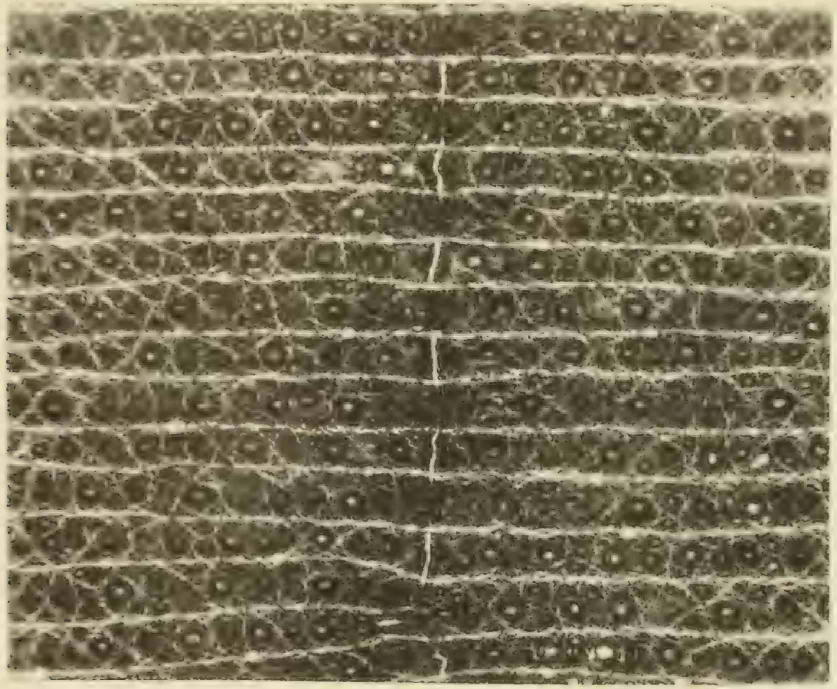
Whether this represents one of the two species (*P. biolleyi*, *P. nicaraguensis* and its variety *isthmicola*) known from Central America, or represents a new form, must await the acquisition of additional specimens.

EXPLANATION OF PLATES.

PLATE 1.

Integument of *Peripatus barbouri,* sp. nov.

Fig. 1. General view of integument. × 25.
2. Showing anastomosis of transverse body folds above insertion of leg.
3. × 27.
4. × 47.



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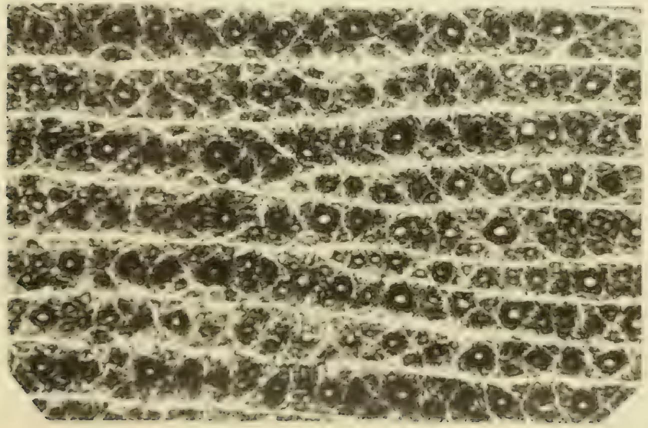

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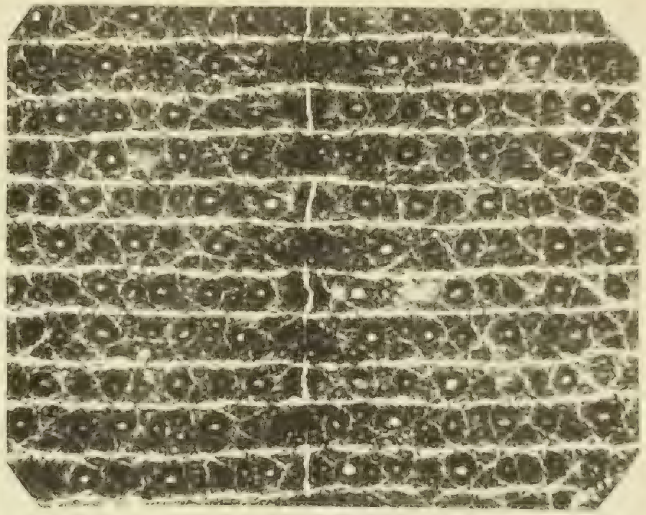

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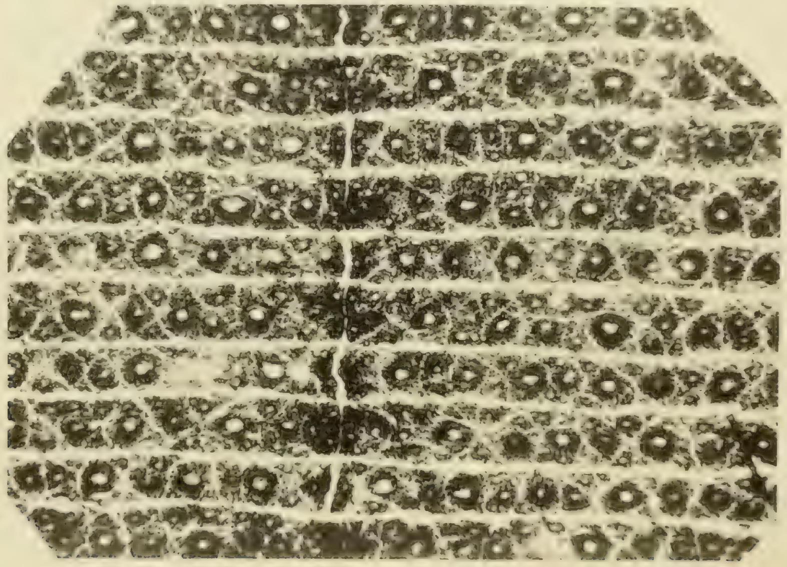

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PLATE **2**.

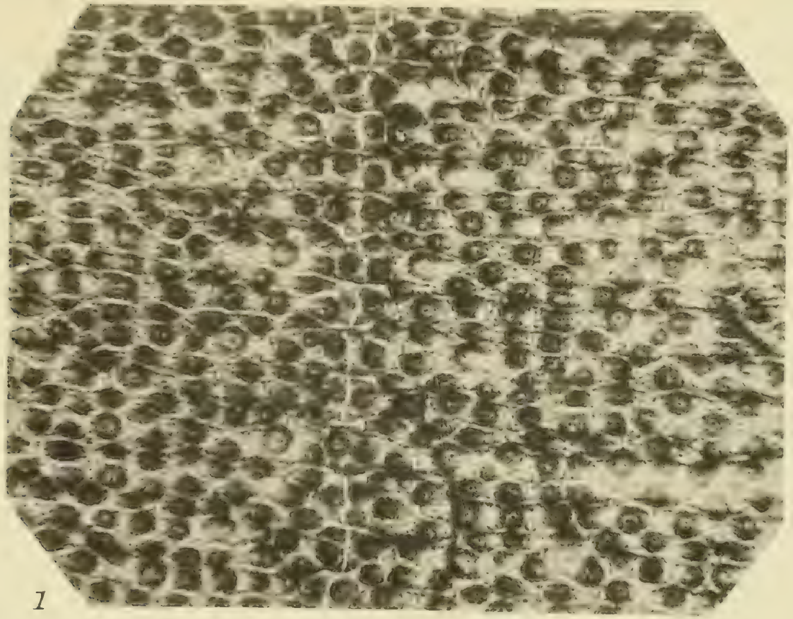
Fig. 1. Integument of *Peripatus juliformis* Guild. var. *swainsonae* Ckll. × 27.

2. Integument of same specimen. × 47.
3. Integument of *Peripatus jamaicensis* Grabh. & Ckll. × 27.
4. Integument of same specimen. × 47.

All preparations photographed by transmitted light.

Peripatus

Plate 2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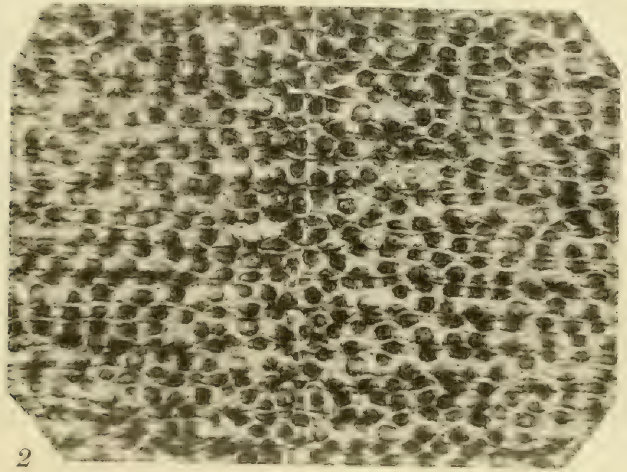
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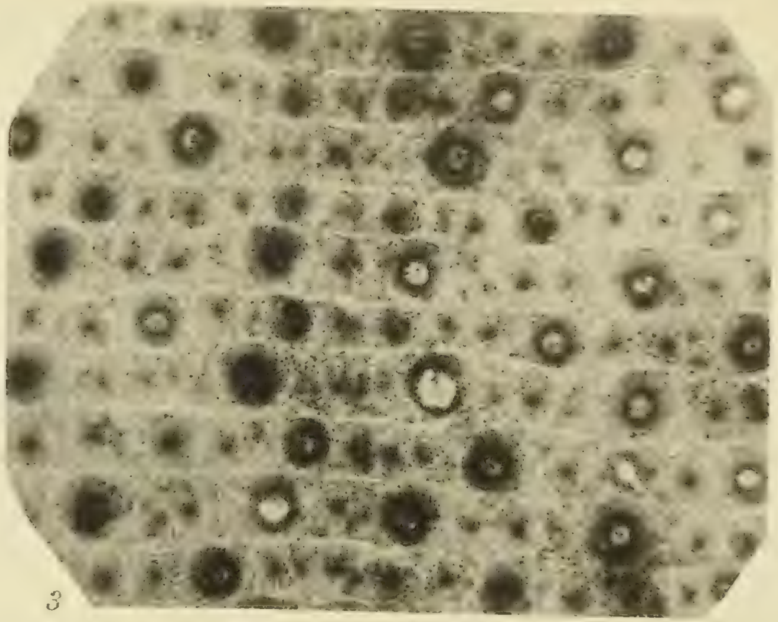
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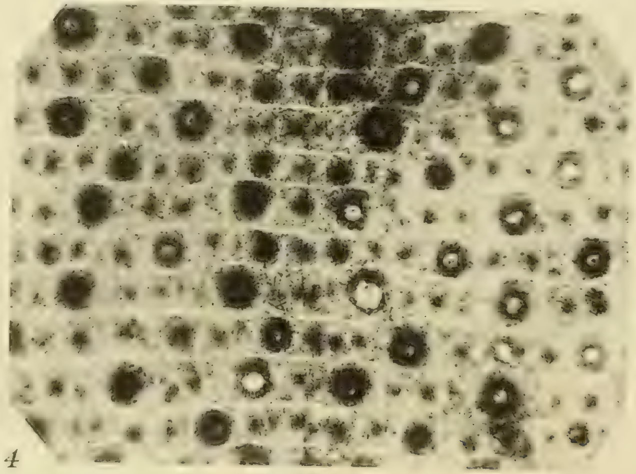
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Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
Vol. LIV. No. 9.

BATS FROM BRITISH EAST AFRICA.

By Glover M. Allen.

CAMBRIDGE, MASS., U. S. A.:
PRINTED FOR THE MUSEUM.
December, 1911.

No. 9.—*Bats from British East Africa.*

By Glover M. Allen.

During the summer of 1909, I accompanied Dr. William Lord Smith and Mr. Gorham Brooks, of Boston, on a brief expedition to British East Africa. From Mombasa, we reached Nairobi by rail, a journey now accomplished within twenty-four hours, and here gathered together an outfit for a ten weeks' march to the region north and west of Mt. Kenia. From the plateau of Laikipia, we followed the course of the Guaso Nyiro to the east, and at length turned southeast, following up a small affluent, the Meru River, to a native town of that name, whence we shortly returned south to Nairobi.

Practically all the bats collected, were obtained in the arid plateau country through which the Guaso Nyiro makes its way. Along the river banks there is more or less verdure, bushes and vines, with occasional large trees, and at lower levels, a scattering of ivory-nut palms and other smaller species. Away from the immediate course of the stream, however, there are great stretches of dry open plain, more or less grass-grown, with scattered thorn trees, or large candelabra-like euphorbias of characteristic shape. This region is of especial interest as marking in some degree the southward extension of certain Abyssinian and Somaliland species. Thus the Grévy's Zebra of Abyssinia here meets the more southern Grant's Zebra, and the Beisa Oryx is found on the plains bordering this stream. It is therefore of much interest that we found *Petalia revoili* and *Eptesicus minutus somalicus,* species described from Somaliland, and here perhaps near their southward limits as species of this arid portion of northeast Africa.

The most remarkable discovery, however, was a specimen representing an undescribed species of Nycticeius, a genus hitherto believed to be confined to the southeastern United States and Cuba. I am indebted to Mr. Gerrit S. Miller, Jr., of the United States National Museum, for examining this specimen and calling my attention to the fact that it is in every way a typical Nycticeius. In addition to this species, a pallid white-winged Eptesicus is described as new.

PTEROPIDAE.

Epomophorus neumanni Matschie.

Epomophorus neumanni Matschie, Megachiroptera des Berliner Mus. für Naturkunde, Berlin, 1899, p. 50.

On the Meru River where it flows through arid plains to the Guaso Nyiro, we found a small colony of fruit bats. There were about twenty in all, old and young of both sexes, all hanging from the midribs of the lowermost fronds of a large palm allied to the sago palm that grew here in the stream bed.

The pale brownish tint of the bats corresponded well with the color of the faded palm leaves, and the great fronds above cast a fair amount of shade. When disturbed they scattered and alighted again in different places, some on the higher twigs of the thorn trees by the brink of the stream, others among the green fronds of a younger palm. Several straddled the midrib of the palm leaf, clinging by the hind feet. Others, when more at ease, depended from one foot only. At all times, though resting, they seemed alert during the day, and were ready to fly if too closely approached. On the morning following the discovery of these bats, I again visited their roost and found some ten or more of them hanging side by side along the midrib of a palm frond. They were awake, but did not fly until I had approached almost within arm's length when simultaneously they scattered in every direction.

Those that were preserved seem a trifle larger than Matschie describes for *neumanni* from the coastal region of British and German East Africa, but otherwise they agree closely enough with his description. The forearm of the male measures 83.5 mm., of the females, 80, 81, as against 77–80 and 73–78 respectively as given by the describer.

Epomophorus pusillus Peters.

Epomophorus pusillus Peters, Monatsb. K. Akad. Wissensch. Berlin, 1867, p. 870.

A single adult male was taken on the Meru River, about a day's march above its junction with the Guaso Nyiro. The stream here flows through an arid grassy plain, and its banks are choked with a dense growth of vines and small trees with here and there a palm allied to the sago, whose long fronds attain often a length of twenty or thirty feet. This palm grows always in the bed of the stream itself, and it was from one of the lower fronds of such a palm that our specimen was taken. Its superficial resemblance in all but size, to *E. neumanni* is very striking, but the white shoulder patches are more prominent, their separate hairs longer than those of the latter, while the belly is slightly paler and the interfemoral membrane naked on its distal half above.

The range of this small species probably includes most of equatorial Africa, although the majority of recorded specimens are from the western part of the continent. Matschie in his monograph of the Megachiroptera (1899) records specimens from Ngoroine between Victoria Nyanza and the Guaso Nyiro of Massailand. These were two females collected by O. Neumann. He also includes Heuglin's *E. anurus,* based on Abyssinian specimens, as a synonym of *pusillus.*

Our specimen is a trifle larger than most of the measurements seen: forearm, 57 mm.; tibia, 23.5; hind foot, 17; head and body, 93.

PETALIIDAE.

Petalia revoili (Robin).

Nycteris revoili Robin, Bull. Soc. Philom. France, 1881, ser. 7, **5**, p. 90; Ann. Sci. Nat., Zool., Apl. 1881, ser. 6, **13**, art. 2, p. 3.

Near our second camp on the Guaso Nyiro there stood at the edge of the stream a large spreading tree whose trunk was hollow. At the ground on one side was an opening large enough to admit a man; and farther up at about ten feet from the roots, a smaller hole in the side of the trunk where a big limb had been broken off. A small colony of bats lived in this hollow tree and just at dusk they emerged one by one from the hole in the trunk and flitted silently away through the gathering gloom. An examination of the interior by means of a lantern in the daytime showed that no bats were clinging to the parts of the hollow within sight, but the discharge of a small-bore shotgun into the narrowing recess at the highest part of the decayed trunk brought down a few specimens in a shower of dust. They had apparently sought the darkest and most remote portion of their retreat. But four individuals were thus obtained for the rest of the colony had evidently withdrawn beyond reach, and subsequent visits on following days showed that they had summarily deserted their resting-place.

It is only after much deliberation that I have decided to refer these specimens to *revoili* described by Robin from Somaliland. They seem to be smaller than Dobson's *aethiopica,* a species to which they are apparently closely related. The type locality of the latter is Kordofan in the Sudan Province, whence Dobson had three skins. No complete measurements of *aethiopica* are available. Dobson's specimens seem to have lacked the forearm bones, and his subsequent details of a Zanzibar specimen (Rept. Brit. Assoc. Adv. Sci., 1881, p. 14) refer in reality to the race *luteola* Thomas. The type of this last is from Kitui, British East Africa, but Thomas states that Zanzibar specimens are identical. It is slightly larger and yellower than typical *aethiopica.* Such measurements as Dobson gives for the type of the latter (Cat. Chiroptera Brit. Mus., 1878, p. 165) are all larger than those of our specimens, and his statement that the fur of the chest and abdomen varies from "yellowish white to pure snow-white" is hardly applicable, for in our series of three skins these parts are uniformly pale drab, with darker gray bases to the hairs. Robin says of his *revoili* that the belly is whitish. His detailed measurements, however, agree very closely with those of our bat, and are certainly much less than those of the East African *luteola,* the type locality of which is hardly 150 miles from the Guaso Nyiro. Probably this is another instance of a species of the Abyssinian fauna reaching its southern limit along this stream.

The cranial measurements, of which none are published, are as follows, from no. 8274: greatest length, 19; basal length, 15; palatal length, 4.3; greatest frontal width, 7.8; mastoid width, 8.3; upper tooth-row, exclusive of incisors, 6.5; lower tooth row, exclusive of incisors, 7; mandible, 12.3. The upper incisors are bifid, and a space separates the pairs of opposite sides from each other and from the canines.

The forearm measures (no. 8871) 42 mm.; tibia, 22; calcar, 15.5; Robin gives 44, 22, 17 respectively for these dimensions in *revoili.* The tail in our three specimens measured in the flesh, varies from 51 to 53 mm.; Robin gives 51.

MEGADERMIDAE.

Lavia frons frons (Geoffroy).

Megaderma frons E. Geoffroy, Ann. Mus. Nat. Hist. Paris, 1810, **15**, p. 192.

Messrs. Andersen and Wroughton (Ann. Mag. Nat. Hist., 1907, ser. 7, **19**, p. 138) consider *Lavia rex* Miller, based on German East

African specimens, as synonymous with *L. frons* whose range they give as including the whole of equatorial Africa from Nigeria and Gambia to Uganda and British East Africa. At the same time they describe from the White Nile a race *affinis* which is separated on the basis of very small average differences in size.

In the arid country along the Guaso Nyiro we found this bat in some numbers. A large candelabra-like Euphorbia is common over large tracts of the plains bordering the river, and wherever a thorn tree and a Euphorbia grew close together and were partly overrun by vines, was found to be a likely resting place for these bats by day. They are very alert, and often the first intimation of their presence on looking up into such a tangle, is the nervous motions of their long ears that at once catch the eye. They easily become alarmed and flit from their covert to another leafy tangle a few yards distant, their wings flashing bright orange in the sunshine. Sometimes several are found together or in close proximity among thorn-bushes, but never more than four or five. On one occasion near midday as I was standing under a large tree in the midst of an open field at Meru, a bat of this species was seen flying, and shortly it came towards the tree and alighted among the middle branches, where it was watched for some while as it hung from a small twig. The diurnal habits of this species are also attested by other observers.

VESPERTILIONIDAE.

PIPISTRELLUS DESERTI Thomas.

Pipistrellus deserti Thomas, Proc. Zool. Soc. London, 1902, **2**, p. 4.

This species is known from but a single specimen, described by Thomas from Tripoli, ten years ago. It is therefore of especial interest to record a second from the arid country of British East Africa, thus extending its known range southward to the equator. The specimen in question is a female and was taken August 11, 1909, near a small stream (the Meru River) that flows through the arid grassy plains to the northeast of Mt. Kenia and joins the Guaso Nyiro. This stream, near its junction with the latter, is bordered by a scattered growth of ivory-nut palms and here, just after dusk, numbers of small bats appeared, flitting low over the water or about the reeds growing along the bank. Most of these were probably *Eptesicus m. somalicus*, though owing to the gathering darkness and their low irregular flight

I was unable to shoot specimens. One, however, was knocked down with a stick as it flew past me, and proves to be identical in every way with the description of Mr. Thomas's specimen. The fur is pale buffy above, slightly paler below, the bases of the hairs everywhere blackish slate. The hinder margins of the wings and interfemoral membrane are conspicuously edged with white, recalling *P. kuhli*, from which, however, it is doubtless specifically distinct. The forearm measurement in the dried skin is 29.5 mm., exactly as given for the type, but the same dimension taken in the flesh was 30. Other dimensions follow, and in parentheses, the corresponding measurements as given by Thomas: head and body, 45 (43); tail, 32 (33); ear, 11 (10); 3d finger, metacarpal, 29 (29); first phalanx, 10 (10); second phalanx, 8.5 (8.5); tibia, 11.5; calcar, 12. Skull, greatest length, 11.5 (11.6); median length above, 10 (10); interorbital constriction, 3 (3.1); breadth of braincase, 6.5 (6.2); front of canine to back of molar^3, 4 (4.3).

EPTESICUS MINUTUS SOMALICUS (Thomas).

Vespertilio minutus somalicus Thomas, Ann. Mag. Nat. Hist., 1901, ser. 7, **8**, p. 32.

Two specimens obtained along the Guaso Nyiro are identical in measurements with those given for this race by Thomas, who says that it is to be distinguished from *minutus*, chiefly by its paler coloring, and by the conspicuous white edge of the wings and interfemoral membrane. The skull is also slightly smaller than that of South African examples. In the alcoholic specimen in our collection, the white edge is plainly evident, but in the dried skin does not appear. The latter specimen may be slightly darker than Thomas's description implies, and there is a sprinkling of pure white hairs in the fur of the lower back, which, however, may be albinistic. Since the Guaso Nyiro region seems to be the southern limit of a number of Abyssinian forms, it is probable that these bats are referable to *somalicus*, rather than typical *minutus*. The type of the former is from Hargaisa, Somaliland, at 3,500 feet, and Thomas mentions additional specimens from Berbera. The forearm measurement is 30.8 mm. in our alcoholic specimen and 31 mm. in the dried skin. Thomas gives 31 mm. for the type specimen.

EPTESICUS PHASMA, sp. nov.

Type.— Skin and skull, male, no. 8279, M. C. Z., collected August 6, 1909, on the Meru River, British East Africa, by Glover M. Allen.

General characters.— A small pallid species (forearm 34), with white membranes; possibly related to *E. tenuipinnis.*

Description.— Color of fur above from nose to root of tail pale dust color, between buff and cream-buff of Ridgway's Nomenclature (1886), slightly darker about the muzzle. Below, the hairs of the chin are buff to the bases paling on the throat to cream-buff and on the belly to pure white. The extreme bases of the hairs of the back, chest, and belly are dark slaty but those of the flanks ventrally are pure white throughout.

Wing membranes from the base of the first metacarpal, extremely thin and delicate; both interfemoral membrane and the wings are whitish throughout, the latter, however, becoming slightly clouded at their tips. Ears, forearms, feet, and tibia pale brownish. The hair of the body extends on to the dorsal side of the interfemoral membrane and on the base of the tail slightly beyond a line joining the knees. Calcar long and slender with a well-marked low and elongate lobe; the calcar does not terminate in a lobule. Tail vertebrae entirely included within the membrane.

Ears small, triangular, their apical margins nearly straight, narrowly rounded at the tips; a prominent basal lobe at nearly right angles to the long axis of the ear at its inner margin; externally the basal notch is well developed and marks off a low rounded basal lobe. Tragus short, of nearly equal breadth throughout, bluntly tapering at its apex; its inner margin straight, its outer margin with a slight notch about opposite the inner base, thus producing two minute lobes at this point. Muzzle with rather conspicuous glandular swellings.

Measurements.— The following measurements of the type were taken in the flesh: — total length, 94 mm.; tail, 40.5; hind foot, 6; ear, 11.5; tragus, 5; forearm, 34; tibia, 12.5; calcar, 14. Skull: greatest length, 13.5; basal length, 10.5; palatal length, 5.4; interorbital constriction, 3.8; zygomatic width, 9; mastoid width, 7.8; upper cheek teeth, front of canine to back of m ^{3}, 4.8; lower cheek teeth, 5.2; mandible, 10.

Skull.— The skull is rather broad, with the anterior edges of the orbits conspicuously ridged so as to produce a rather squarish rostrum. Upper incisors directed sharply inward; the inner is simple, about twice the length of the outer; outer incisor with a conspicuous cingulum cusp externally. The two teeth are placed in a line nearly at right angles to the long axis of the skull. Canine with an antero-internal cingulum cusp. Crowns of the lower incisors trifid, slightly overlapping; first lower premolar about three fourths the length of the second.

Remarks.— This white-winged bat does not seem referable to any of the described species. It is possibly related to *E. tenuipinnis* of West Africa, but is larger, paler, the tail is entirely included in the membrane, and the tragus has two minute pointed lobules. It is equally distinct from *E. rendalli* (Thomas) from Gambia, which also has white membranes. The latter has large hind-foot pads, the calcar ends in a projecting point, and there is a penis bone present, which *E. phasma* does not have. The upper incisors are also different, being provided with two cusps in *rendalli.*

This bat was first noticed on the Guaso Nyiro at its junction with the stream from Meru, in the arid country to the northwest of Mt. Kenia. Here it was seen but once, when at dusk a single individual, conspicuous for its white coloration, was observed flying about over the river in company with numbers of small dark bats, probably *E. minutus somalicus.* A few miles farther up the Meru River (above the ivory-nut palm region) it was much commoner. At our camp by the side of this small stream numbers were observed and several were shot in the early evening as they flew past following the course of the rivulet, which here flows through a sun-baked plain with few trees except along the water course. Its flight is very steady, direct and rather slow, so that it was easily shot. In the gathering dusk, however, the white wing membranes were almost invisible against the sky, thus producing a curious ghostly effect, as only the body and forearms could be clearly seen.

NYCTICEIUS AFRICANUS, sp. nov.

Type.— Skin and skull, male, no. 8272, M. C. Z., collected August 11, 1909, on the Meru River, British East Africa, by Glover M. Allen.

General characters.— A typical Nycticeius, slightly smaller and much paler than the *N. humeralis* of the southeastern United States, with shorter closer fur. Postcalcaneal lobe well developed.

Description.— Fur of the upper surface of head and body, short and close, about 4 mm. long on the lower part of the back, of a uniform pale wood-brown quite to the bases of the hairs; below cream-buff to the bases of the hairs. The muzzle in front of the eyes is nearly naked.

Wing membranes dark, and attached at the base of the first digit of the foot. Ears pale brownish. Hair of the body does not extend on to the interfemoral membrane. Calcar well developed with a conspicuous, low, rounded lobe at about 3 mm. behind the heel. Tragus with a distinct external basal lobe. Tip of tail free from the interfemoral membrane.

Skull.— The skull of the type is scarcely to be differentiated from that of the American species, *N. humeralis*, except by its slightly smaller size. The upper incisors, however, are set much more nearly at right angles to the long axis of the skull, so that viewed from above they hardly project beyond the premaxillae, whereas in *humeralis* they extend prominently forward.

Measurements.— The following measurements were taken in the flesh: total length, 85 mm.; tail, 35; hind foot, 6.5; tibia, 13; calcar, 17.5; ear, 12; forearm, 33. Third metacarpal, 29.7.

Skull: greatest length, 13.6; basal length, 10; palatal length, 5; interorbital width, 4; zygomatic width, 9.4; mastoid width, 8; upper cheek teeth, front of canine to back of m^3, 4.5; lower cheek teeth, 5.3; mandible, 10.2.

Remarks.— The discovery in East Africa of this genus hitherto known only from the southeastern United States and Cuba is one of the most important and interesting results of our expedition. Mr. Gerrit S. Miller, Jr., who examined the specimen, first called my attention to the fact that it is in all respects a typical Nycticeius, agreeing with the American species in all essential characters. The postcalcaneal lobe is well developed in the African but scarcely at all in the American bat, and the incisors of the former are less projecting, but otherwise they differ hardly at all except in color and size.

The single specimen on which this species is based was shot shortly after sunset as it was circling about in an open space among the ivory-nut palms by the Meru River. The river here runs through a dry plain, and no doubt the pale coloration of the species is due to the arid conditions under which it lives.

From a zoögeographic point of view the discovery of this genus in Africa is of extraordinary interest. Its case is somewhat paralleled by that of Mormopterus which occurs in Cuba, South America, Africa, and Madagascar. Possibly Nycticeius may yet be found to occur in South America.

Scotoecus hindei Thomas.

Scotoecus hindei Thomas, Ann. Mag. Nat. Hist., 1901, ser. 7, **7**, p. 264.

The type of this little-known species was taken at Kitui, British East Africa, 3,500 feet altitude. What appears to be the third recorded specimen is an adult male collected August 2, 1909, by our expedition. It was found under a loose flake of bark on a large tree growing by the bank of the Guaso Nyiro a few miles above its junction with the Meru River, a small stream which, like the former flows through a semi-desert country. The specimen (no. 8870) agrees in all essential respects with the description of *S. hindei*, except that on each side of the upper jaw there are two premolars instead of the single large p^4 typically present in the genus. The extra tooth is a very minute spicule, visible only with a hand lens, and is crowded into the internal angle between the canine and the large premolar. Its height is less than that of the cingulum of the adjacent teeth, and it must have been practically functionless. Wroughton (Mem. and Proc. Manchester Lit. and Phil. Soc., 1907, pt. 2, no. 5, p. 4) has recorded the second known specimen of this species. It was taken far to the south of the type locality, at Petauke, Rhodesia. This specimen likewise had a minute second premolar in the upper jaw, described as "fitting into a notch in the inner side of the cingulum of the canine." A similar notch is said to be present in the type, but there is no trace of the minute premolar, nor is there either tooth or notch in the known examples of *S. albofuscus* and *S. hirundo*. In our specimen of *S. hindei* there is no notch in the canine for the reception of the minute premolar. In a fourth species of the genus, *S. albigula*, recently described from Mt. Elgon by Thomas (Ann. Mag. Nat. Hist., 1909, ser. 8, **4**, p. 544) this minute tooth, considered by Thomas to be p^1, is present on either side, in or close behind a deep notch in the cingulum of the canine.

The genus Scotoecus is doubtless in process of losing the first premolar and those specimens in which it is lacking are to be looked on as progressive variations in which it has dropped out altogether. This tendency to condensation of the molar series is found in many bats, and is seen for example, in an interesting specimen of the red bat, *Nycteris* [= *Lasiurus*] *borealis*, no. 9736, M. C. Z., from Martha's Vineyard, Massachusetts. In the skull the small anterior premolars are absent on each side of the upper jaw, and the large p^4 quite fills the space between canine and molars. It represents a progressive variation in the development towards the condition in which there will be normally but the single large premolar present.

MOLOSSIDAE.

CHAEREPHON HINDEI (Thomas).

Nyctinomus hindei Thomas, Ann. Mag. Nat. Hist., 1904, ser. 7, **13**, p. 210.

This beautiful white-winged bat was originally described from Fort Hall, an outpost to the south of Mt. Kenia. While passing through this place we were shown a colony of bats, doubtless of this species, that inhabited the interspace between roof and ceiling of a house. Ingress was had through a small crack at the corner of the roof. No specimens were obtained here, but at Mombasa, on the coast, a single one was captured by the Swahili boys on the hotel veranda at night. Its forearm measurement is slightly smaller than that given for the type, namely 37 as against 40 mm. Moreover, the wing membranes are whitish to the tips and there is no noticeable white flecking on the back.

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XXIV.

A PECULIAR FORM OF SCHIZOGONY IN GONYAULAX.

BY CHARLES ATWOOD KOFOID AND E. JOSEPHINE RIGDEN.

WITH TWO PLATES.

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No. 10.— *Reports on the scientific results of the Expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, by the U. S. Fish Commission Steamer "Albatross," from October, 1904, to March, 1905,* Lieut. Commander L. M. Garrett, U. S. N., *Commanding.*

XXIV.

A peculiar form of Schizogony in Gonyaulax.

By Charles Atwood Kofoid and E. Josephine Rigden.

A single chain of Gonyaulax which presents unequivocal evidence of a type of reproduction unknown elsewhere among the Dinoflagellates occurs in the collections of the Expedition to the Eastern Tropical Pacific. Since so little is known regarding the process of reproduction in this order of Protozoa it seems advisable to place this case on record and to note its relations to our meagre information on other types known in the group.

This chain was taken in the vertical haul of the No. 20 silk net made October 13, 1904, at Station 4590, from a depth of 300 fathoms off the Mexican Coast over Manzanillo Basin, 18° 58′ N., 104° 50′ W., in surface temperatures of 82°–83°. It consists (Plate **1**, figs. 1, 2) of eleven individuals in chain, the sixth or middle member being the largest, while the transdiameter of the individuals decreases quite regularly towards either end. In the view presented in Fig. 1, ventral for the distal members of the chain and oblique for the three centrally located ones, the transdiameters are respectively 38, 39, 41, 45, 55, 68, 65, 57, 42, 40, and 27 μ, for the eleven members of the chain. There is no proportionate decrease in the length of the individuals. They range from 25 to 35 μ with the single exception of the central member which is about 45 μ long. The shorter members are the more distal ones and those of the posterior half are somewhat shorter than in the anterior half. The volumes, roughly computed, run, from the anterior end posteriorly in the ratios of 3, 4, 5, 6, 9, 20, 13, 8, 4, 4, 2. The posterior five as a result of their greater transdiameters are thus somewhat larger, in spite of their lesser altitude.

This greater size of the posterior members of the chain is often seen also in Ceratium chains where the antapical horns are longer toward the posterior and shorter toward the anterior end of the chain. See figures of chains by Pouchet (**1894**), Karsten (**1907**), and Kofoid (**1908**, fig. 10) where the antero-posterior gradation is very marked. The chains of Ceratium are in active locomotion during chain formation. It is quite possible that the direction of locomotion may in some way influence the distribution of the plasma of the parent cell to the daughters in such a way that the posterior member receives the greater part. The resistance of the medium to locomotion in an anterior direction would tend to have this effect upon the plastic living substance.

Far more significant than this antero-posterior dissimilarity in the members of the chain is the progressive reduction in size towards both of the distal ends of the chain. This is evidently due to a dominating factor which overrides the tendency for the posterior member to be larger than the anterior above referred to. It is practically impossible with the data at hand to unravel the sequence of cell divisions which gave rise to this chain. Two possible causes suggest themselves as operative, first, unequal cell division, with the smaller member in each case the distal one, but the inequality less in the posterior region than anteriorly; second, more rapid cell division in the distal regions. The volumetric relations of the members of the chain are such that the first to the fourth and eighth to eleventh individuals may be one or even two generations older than members five, six, and seven. Assuming that the eleven members constitute the complete chain, and this seems probable from the condition of the plasma at the ends. It is hardly possible to devise a scheme of descent without bringing in both unequal division and inequality in the rate of division. This inequality in the results of the process of schizogony has an important bearing on the interpretation to be put upon the chain in question, and in differentiating it from previously known forms of schizogony in the Dinoflagellata.

Schizogony in the Dinoflagellata is of several kinds each of which bears some relation to the presence or absence of exoskeleton or theca and to the part which this, when present, plays in the process. The extent to which protoplasmic continuity is retained after nuclear division determines the possibility of chain formation. The following table exhibits a classification of types of schizogony and the place which the type here presented occupies in the scheme.

Body naked
  Schizonts parted at once on fission. Most Gymnodinidae.
  Schizonts retaining temporary association in cyst. *Gymnodinium lunula.*

Schizonts retaining a temporary connection in chain. *Gymnodinium geminatum.*

Schizonts permanently associated in short chains (colony) without much transverse constriction. *Polykrikos auricularia.*

Body of schizonts thecate.

Parental theca retained and shared by schizonts.

Schizonts detached at once upon fission. *Gonyaulax spinifera,* many species of Ceratium, Steiniella, Ceratocorys, and most of the Dinophysidae.

Schizonts retaining connection for some time after fission.

By dorsal thecal attachment. *Dinophysis geminata,* Ornithocercus.

By protoplasmic connection between distal end of girdle of anterior schizont and apical pore of posterior one, establishing true chain formation. Many species, of Ceratium (*C. candelabrum, C. vultur, C. palmatum*), *Gonyaulax catenata.*

Entire theca newly formed on schizonts.

Parental theca shed by ecdysis. No chain formation.

Prior to fission. Sometimes in *Gonyaulax spinifera* (see Schütt, 1887) also in *G. polyedra.*

After fission, schizonts closely packed in parental theca but not attached to one another. *Pyrophacus horologicum.*

Chains of schizonts formed with complete polar protoplasmic attachment retained for some time. New theca on schizonts formed progressively toward distal ends of chains. *Gonyaulax series.*

The skeleton of the species here described is certainly not formed until after division, if we may trust the evidence of the posterior member of the chain. This, as appears plainly in the specimen (Plate **1**, figs. 1, 2), is covered throughout by a thin pellicle in which no sutures are as yet visible. No part of an ancestral skeleton has been transferred to this distal and posterior daughter cell in the process of division and it is apparently in the first stages of forming an entire new skeleton, in the same fashion as a new one is formed from the delicate peripheral pellicle secreted about the naked plasma in *Gonyaulax polyedra* or in *G. polygramma* where the whole skeleton has been shed by ecdysis or on the schizonts emerging from the mother theca in Pyrophacus. There is then in this species no transmission of ancestral skeletal parts during the process of fission which results in chain formation.

The polar protoplasmic continuity of schizonts exemplified elsewhere in Polykrikos is here even more extended in areas and persists moreover through more generations and individuals. To this is added the formation *de novo* of an entire new skeleton such as is seen in some other species of Gonyaulax after ecdysis with or without free cell division.

The interpretation of the condition of the anterior member of the chain from which the epitheca is missing is difficult. The protoplasmic contents are intact and show no conclusive evidence of breakage yet the adjacent hypotheca and girdle plates are fairly well formed. It is possible that the epitheca has been accidently torn away or shed as the result of some physiological condition of the cell body. On the other hand it is obvious that another division of the distal member remains possible without thecal fission, ecdysis, or rupture so long as the theca is not formed about the end of the protoplasmic cell body. The posterior member of the chain is entirely enclosed in a delicate pellicle except where it joins its neighbor. Should the whole of this metamorphose into thecal plates the further progress of fission in that region without skeletal fission, ecdysis, or rupture of the hypotheca and budding will be definitely stopped.

The difference between this chain of *G. series* and that of *G. catenata* or of a typical Ceratium chain will be best appreciated if one compares Levander's figures (Plate **2**, fig. 6) together with one of a bit of Ceratium chain (Plate **2**, fig. 5) with those of *G. series* (Plate **1**, figs. 1, 2; Plate **2**, fig. 5). It will be seen that in *G. catenata* and in Ceratium chains generally, the schizonts are of equal size and similar proportions (except in the antapical horns) and present similar markings. It is only immediately after fission or rarely among members of a chain that the old and newer parts of the theca which has recently undergone fission can be readily distinguished. The schizonts of *G. series* on the other hand diminish in size progressively toward the ends of the chain. The posterior theca is wholly in the earliest stages of formation, and the anterior ones also have their suture lines less developed, and the epitheca is not formed (or has been removed) on the most anterior member. There is evidence neither of skeletal fission nor skeletal transmission.

Another striking difference between the chain of *G. series* and the others is in the method of attachment of the adjacent members. In Ceratium (Plate **2**, fig. 6) the attachment is by a slender protoplasmic strand emerging from the apical pore of the posterior schizont and passing into the cell body of the anterior member at the ventral edge of the distal end of the girdle at the point where the girdle abuts against the ventral area. It is in a precisely homologous position that the connection is made in *Gonyaulax catenata* (Plate 2, fig. 5). Upon detachment a small scar or attachment area (*att. area*) is visible on *G. catenata* in this region. In *G. series* on the other hand the adjacent schizonts are attached by very broad polar regions of cell plasma which preclude the formation of nearly the whole apical series and the anterior intercalary (if any exists) plates on the epitheca and much of the antapical plate and the posterior and possibly several intermediate plates of the ventral area. The lower part of the posterior intercalary is also suppressed. We find no evidence that these plates are forming inside of the line of junction of adjacent thecae. The theca wherever formed is wholly exposed. The region in *G. series* homologous to the attachment pore of *G. catenata* is apparently fully exposed, especially in anterior members of the chain and no evidence of a specialized "attachment area" appears elsewhere. It is possible that the attachment region in *G. series* will be formed in a more posterior location or that these areas are not homologous in different species of the same genus, but it seems from the evidence in hand more probable that in general these regions are homologous but that in *G. series,* in the absence of skeletal fission, the *de novo* origin of the theca while the schizonts are still in chain but subsequent to nuclear division and some protoplasmic constriction, profoundly modifies the relations of adjacent thecae in this matter of the attachment area. The later history of the chain must be known and the completion of the constriction between adjacent schizonts be observed, in case it occurs, before the final skeletal relations of the attachment regions can be determined. It is quite possible that they are of a wholly different type in *G. series* from that acquired in schizogony when this is accomplished by skeletal fission as in Ceratium and in *Gonyaulax catenata.*

The striking feature in which this chain of *G. series* throws new light on the process of reproduction in the Dinoflagellata and at the same time adds to its complexity, is the formation, *de novo,* of the theca, following schizogony in which the members take on a linear arrangement and at the same time retain nearly the maximum possible protoplasmic continuity.

In Pyrophacus, for example, the two, four, eight, or sixteen daughter cells or spores escape from the mother theca and synchronously each converts its thin hyaline pellicle into a complete sutured theca. The association of the daughter cells within the mother theca is that of crowded but independent non-attached cells which upon their release are wholly independent of one another. In *Gonyaulax series* the daughter cells remain broadly attached and the thin pellicle upon the surface of each is transformed into the sutured theca with the plates normal to the region, while those parts of the theca normal to the surface of the cell body as yet unexposed because of the protoplasmic continuity of adjacent schizonts, remain unrepresented in the transforming pellicle. Moreover in *Gonyaulax series* these schizonts do not soon lose their protoplasmic continuity but they form the same type of pellicle as in Pyrophacus on their exposed surfaces and this is then progressively instead of synchronously differentiated by suture lines into the Gonyaulax type of theca.

The differences in size of the schizonts and their progressive differentiation of the theca distally in *G. series* indicate that the schizogony may not be coincident in all members of the forming chain but that division is irregular and localized and that the later divisions result in the formation of the more distal and smaller members of the chain. Assuming the chain to be complete it appears both on the ground of dimensions and of the peculiar twisting of the three centrally located members from the common axis of the remaining eight, that the chain falls into three regions, two distal groups of four each and a central group of three large individuals, and that the distal groups represent later generations of descent than the larger central ones.

The previous stages and those subsequent to the one here observed can only be conjectured. The normal course would be that the constrictions separating the individuals should deepen and finally result in the complete separation of the schizonts and the completion of the individual thecae. The presence of such an abundant supply of starch grains (*st. gr.* Plate **2**, fig. 3) in each cell arranged in a broad equatorial zone about the nucleus (*n.*) is indicative of predominant synthesis, that is, of a condition favorable to rapid growth. The sheath of incomplete thecae surrounding the dividing mass of cytoplasm is a striking instance of the plasticity of the Dinoflagellate theca. The rigid conformity of each partial theca to the specific type is an even more striking illustration of the expression of the structure of the individual, in this case a single cell, while still in cytoplasmic but not nuclear continuity, with its sister individuals. The cytoplasm is scarcely individualized, at least by discontinuity, but the nuclei and the discrete skeletal structures in so far as opportunity is afforded for their formation attain their complete individual realization.

In a recent paper Apstein (**1910**) has described a process of budding in Ceratium which bears certain resemblances to the type of reproduction here described. His outline drawings unfortunately afford no critical evidence of the precise skeletal relations of the two cells. In the case of Ceratium described by him the budding cell arises by nuclear division, one sister apparently retaining the whole parental skeleton and the other and smaller one seemingly forming an entirely new theca. The resemblances in this phenomenon to that here described lie in the formation of an entire new theca on the "bud" and in the initial difference in size in two daughter cells in Ceratium which is comparable with the underlying inequality in division which has given rise to the Gonyaulax chain. The marked differences between the two lie in well-defined chain formation in *Gonyaulax series,* while in the budding Ceratium it is not conclusively evident either from Apstein's text or his figures that this process of budding ever leads to chain formation, while, if his interpretation of "abgefallene Knospen" be correct chain formation following budding must be at the best exceedingly rare. As a result protoplasmic continuity is absent and skeletal completeness upon the bud is possible. There is also in the Gonyaulax chain, as found, no such marked contrast between the "bud" and its sister cell in the matter of size and skeleton as appears in budding Ceratium.

The organism here dealt with is not assignable to any described Dinoflagellate and its full thecal structure is so imperfectly revealed or developed that a full determination of its position and relationships is impossible. Some clues as to its affinities are suggested by the plates as developed. The hypotheca is that of Gonyaulax, with one antapical, $1''''$, one posterior intercalary, 1^p, and 6 postcingulars, $1'''$–$6'''$, of which $1'''$ is a small plate. These same features pertain to the hypotheca in certain other genera, Amphidoma, Ceratocorys, and Steiniella. In Amphidoma the girdle is not displaced; it is in all species of Gonyaulax. In Ceratocorys there are but four precingulars; in Gonyaulax there are six as here. In Steiniella there are in all known species peculiar vermiculate surface markings, and an apical closing platelet is peculiarly elongated; both of these features are lacking or less prominent in Gonyaulax. In this species the surface is unmarked and the apex indeterminable. In view of the evident close relationships of Gonyaulax and Steiniella and the absence of decisive characters leading toward the latter genus it seems best to assign this species provisionally to Gonyaulax pending the discovery of the full complement of plates.[1]

In a recent paper (Univ. Calif. Publ. Zool., v. 8) the senior author has reduced Steiniella to a subgenus of Gonyaulax.

The fact that there is no "longitudinal furrow" extending upon the epitheca to the apex as figured in nearly all of the described species of Gonyaulax and presented as a generic character by Bütschli (**1885**) and Schütt (**1896**), is in my opinion without significance. As we have shown in a recent paper this reputed furrow upon the epitheca is merely the narrow midventral apical plate 1′, often guarded by lateral ridges so that it appears to form a trough. It is in no sense a part of the furrow occupied by the longitudinal flagellum and is not structurally differentiated from the rest of the thecal wall. It is, moreover, not present as a trough or furrow in some species of Gonyaulax in which apical plate 1′ has a greater width than usual and has been unduly emphasized in the figures of species in which it is narrow. To treat this region as a longitudinal "furrow" is to obscure its function and make still more difficult a correct diagnosis of this exceedingly perplexing genus.

It is at once evident upon inspection of Levander's (**1894**) figures and description of *Peridinium catenatum* that it and the form here described are closely related. In Levander's material the apical and antapical regions are revealed on isolated individuals and also in specimens in chain. He gives an analysis of these regions but assigns the species to the genus Peridinium, possibly because it shows a slightly expanded ventral apical (Rautenplatte) and has plates which might be interpreted as dorsal intercalaries in the terminology which I have elsewhere applied (Kofoid, **1909**) to Peridinium. The hypotheca has, however, a wholly different composition as to plates from that in Peridinium and one perfectly typical of Gonyaulax. It has but a single antapical while Peridinium has two. Levander specifically mentions the single antapical but fails to differentiate the posterior intercalary the existence of which, however, is plainly suggested in his text figure 4 and figures 1 and 3 of his plate. The distribution of the four or more spines along the angulate margin of the antapical plate is similar to that in *G. triacantha* and *G. ceratocoroides.*

This type of plate structure in the hypotheca is so characteristic of Gonyaulax that it seems best to transfer Levander's species from Peridinium and to refer to it as *Gonyaulax catentata* (Levander). See Kofoid "On the skeletal morphology of *Gonyaulax catenata* (Levander)" in Univ. Calif. Publ. Zool. v. 8, 1911. Should it become necessary in the future to break up the genus Gonyaulax into smaller genera Levander's species and the one here described might be kept together. The peculiar arrangement and number of apical plates in Levander's species is without precise parallel among the known species of the genus. It is evidently closely related to *G. triacantha.* Further material is necessary to determine the character of this region in the form we have found.

The accompanying figures, A and B, give the arrangement of plates and structure of the ventral area in *G. triacantha.* They will make clear the affinities of the organism here described to Gonyaulax and also the general resemblance between *G. triacantha* and *G. catenata,* in form, plates, and antapical spines. Our analysis of *G. triacantha* is based upon actual separation of the elements along the suture lines as drawn. The analysis of the theca hère given is a correction of the analysis previously given by the senoir author (see Kofoid, **1906**) in that two anterior intercalaries are added and the interpretation of the apical region is modified, one small postcingular $1'''$ is added and the "accessory plate" is here called the posterior intercalary.

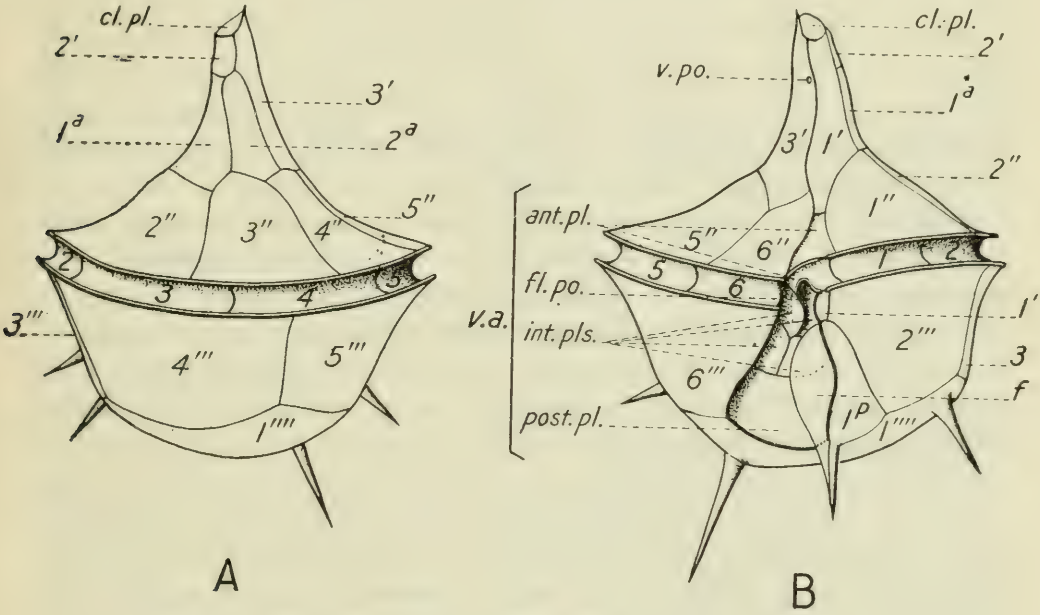

Fig. A. *Gonyaulax triacantha* showing arrangement of plates.
Fig. B. Ventral view of the same. × 467.

It is not possible to determine from Levander's (**1894**) or Vanhoffen's (**1897**) figures of *G. catenata* or from Levander's discussion whether the skeleton undergoes fission or not, that is whether the chain formation is of the same type as in Ceratium or similar to that described here for *G. series.* The fact that the schizonts are of uniform size and similar appearance suggests that skeletal fission has taken place but does not conclusively prove it. Further corroboration is seen in presence of an attachment pore near the distal end of the girdle in Levander's species, which provides for protoplasmic continuity of the type seen in Ceratium (Plate **2**, fig. 6) where skeletal fission occurs. That the chain formation is of the usual type has been revealed by an examination of material kindly sent by Dr. Levander.

Gonyaulax series, sp. nov.

Plates **1**, **2**, figs. 1–4.

Diagnosis:— A rotund (?) species with hyaline theca free from markings, girdle displaced 1 to 2 girdle widths. Forming chains in schizogony without skeletal fission.

Description:— *Body* rotund (?), dorsoventral and transdiameters nearly equal, flattened slightly on ventral face. *Epitheca* with shoulders sloping more rapidly than hypotheca. *Girdle* equatorial, descending, displaced distally one to two girdle widths, furrow deeply impressed with thin salient ridges of thecal wall without lists. *Ventral area* scarcely indenting the epitheca, longitudinal furrow widening distally to at least three girdle widths.

Plate formula not fully known; (?)′, $(?)^{a}$, 6″, 6.6‴, 1^{p}, 1⁗. Owing to the non-development of the apical and antapical regions, the number of the *apicals* (1′ to ?) and *anterior intercalaries* (1^{a} to ?) is unknown and the relations to the single antapical are not revealed. We interpret the rhomboidal plate anterior to the flagellar pore (*fl. po.*, Plate **2**, fig. 4) as the ventral *apical* (1′) because of its relationships to precingulars 1″ and 6″ which it separates as in most other species of the genus. The plate contiguous to its anterior right margin is either an *anterior intercalary*, 1^{a} or the distal (passing about the apex in the direction of the flagellum) member of the apical series, the number in which is not shown in any member of the chain. What is apparently apical 2′ (labelled 2′ (?) in Plate **2**, fig. 4) appears only on number six of the chain. There are 6 *precingulars* (1″ to 6″, Plate **1**, figs. 1 and 2), the typical number for, and exhibiting the typical arrangement in Gonyaulax. Plate 6″ is quadrangular, as in the *G. polygramma* group and others with girdle slightly displaced. The six *postcingulars* 1‴ to 6‴, are likewise of characteristic number and arrangement, plate 1‴ being a minute linear plate on the left edge of the longitudinal furrow. The *posterior intercalary*, 1^p, is extraordinarily wide for this plate, and the *antapical* is revealed only along its posterior margin ($1''''$, Plate **1**, fig. 2). The possibility of several antapicals as in Goniodoma must be kept open in view of the incompleteness of the thecae in this region. If present a different generic assignment will be necessary.

The plates of the *ventral area* (see fig. B, *v. a.*) are not all present and it is difficult to distinguish this region in the middle of the chain, for example, from the ventral apical region of the next posterior member of the chain. The interpretation in the anterior part of the chain of the plates of the epitheca is so conclusive that the analysis in the less sharply differentiated, more central members (Plate **2**, fig. 4) is however, made possible. Five plates of the ventral area (*v. a.*) can be distinguished. These are the anterior plates (*ant. pl.*) opposite the end of the transverse furrow, with a slight anterior lobe indenting the epitheca, and posterior to this two pairs of intermediate plates (*int. pls.*) which abut posteriorly directly against the midventral apical, $1'$ and the plate conditionally interpreted as the anterior intercalary, 1^a of the next posterior schizont. The plate immediately adjacent to the proximal end of the girdle marks the region of the flagellar pore (*fl. po.*).

The *surface* of the theca is absolutely smooth, without trace of markings or pores and the wall is a delicate hyaline membrane whose only structural features are the barely outlined sutures which in the distal members of the chain are not always demonstrable.

The same pattern of skeleton is exhibited throughout all members of the chain, the only differences being those resulting from variations in differentiation of sutures and in size and extent of union of adjacent thecae which in the three larger members results in considerable modification in size, proportions or expanse of the plates. The thecal formation has not progressed equally in all portions of the chain. In the central members the sutures are more evident and those of the ventral area can be determined. Distally in the four members at either end the sutures are exceedingly faint or even not demonstrable under the best conditions of magnification and illumination.

The *cell contents* (Plate **2**, fig. 3) form an unbroken axial mass of cytoplasm which is nowhere constricted between the schizonts to a total depth on the two sides exceeding one third of the equatorial diameter of the adjacent cell bodies. In fact in the central part of the chain the constrictions are even less developed. The plasma is densely granular and upon treatment with iodine, clusters of small spherical granules (*st. gr.*, Plate **2**, fig. 3) arranged in a broad band, mainly equatorial in position, take on a blue color indicating the presence of starch in the territory adjacent to the nucleus.

The demonstration of the nuclei in this protoplasmic mass was a matter of great difficulty and remains still in considerable uncertainty. The material had been preserved in rather strong formalin and even after subsequent treatment with reagents such as Schaudinn's sublimate-acetic and with Fleming's fluid and attempts to stain with picro-carmine, Guebler's haematoxylin-eosin, Arnold's stain, and Morell and Salon's rubincresyl-blue, no clear and conclusive nuclear outlines could be sharply demonstrated in the densely granular mass. Decolorization sufficient to clear the granular mass left no stain in the nuclei. Certain pale faintly granular areas of ellipsoidal form centrally located in each member of the chain have been provisionally interpreted by us as nuclei (*n.*, Plate **1**, fig. 3).

DIMENSIONS: length 25 to 45 μ (incomplete in chain); transdiameter, 27–68 μ: dorso-ventral diameter about the same; width of girdle about 5 μ.

VARIATION: In size the variation is considerable. There is also some variation in the displacement of the girdle.

COMPARISONS: Differs from *G. catenata* as shown below.

	G. catenata (Lev.)	*G. series,* sp. nov.
Surface	reticulate	smooth
Antapex	with spines	without spines
Length	23–24 μ.	25–45μ (incomplete)
Transdiameter	31 μ.	27–68 μ.
Distribution	northern, neritic, brackish	tropical, oceanic.

It is obviously impossible to settle the matter of relationships of the two forms until the fully developed theca of *G. series* with its apical and antapical regions and its surface markings, if any, are known. Levander's species has thus far been reported only from northern and eastern Baltic, Limfiord (Denmark), and the west coast of Greenland, that is from cold and somewhat brackish coastal waters. Of *G. series* but one chain has been taken and that in oceanic conditions in tropical waters.

SUMMARY.

Gonyaulax series, sp. nov. presents a unique type of asexual reproduction (schizogony) resulting in the formation of a linear chain in which the schizonts are united in their polar regions with but slight constriction separating the successive members of the series. There is no evidence of skeletal fission but the chain is thecate. The entire theca, except in polar regions of contact, is found in initial stages of formation on the distal members of the series. A progressive reduction in size passes from the central to the distal members. Fission thus appears to progress most rapidly in distal parts of the chain and to be followed by the formation of the theca upon exposed parts of the cell body.

Anterior schizonts are smaller than the posterior ones suggesting the effect of the direction of locomotion.

Levander's *Peridinium catenatum* belongs rather to the genus Gonyaulax. Its schizonts are uniform in size. Skeletal fission in the formation of chains occurs in this species.

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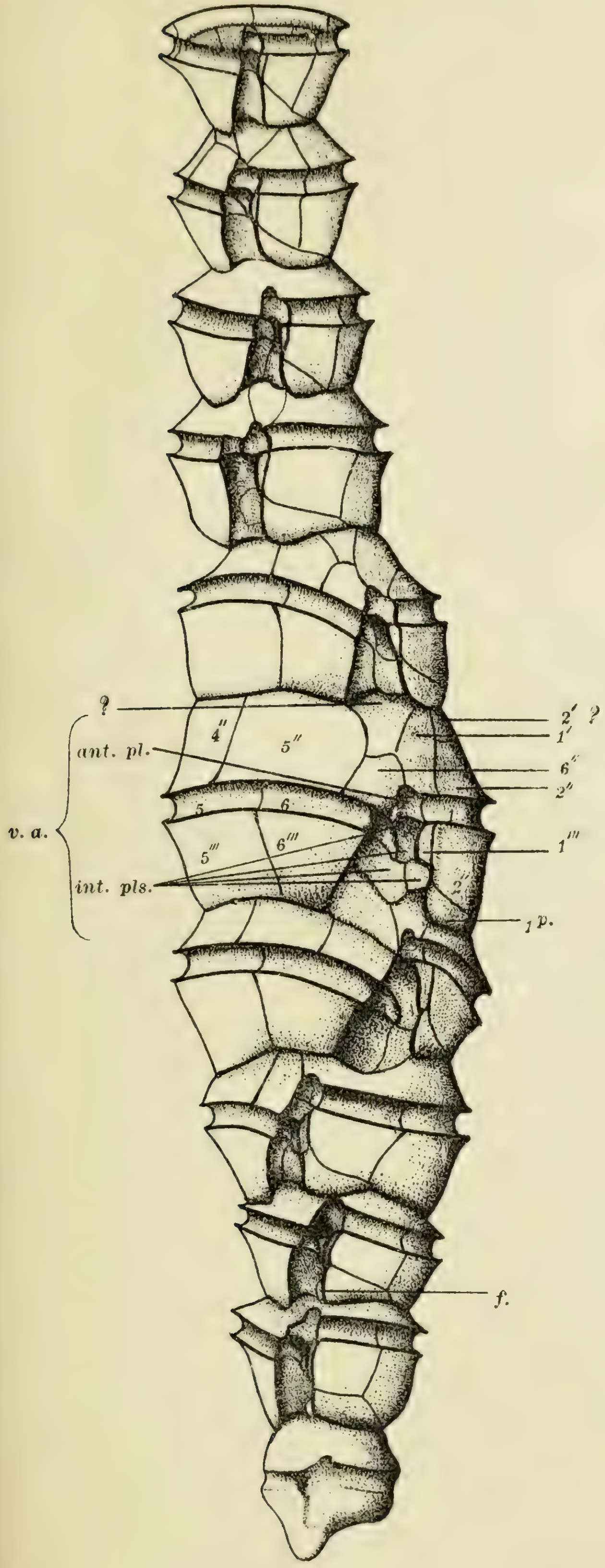
Explanation of abbreviations in figures, text, and plates.

1′–3′, apicals.
1^a–2^a, anterior intercalaries.
1″–6″, precingulars.
1‴–6‴, postcingulars.
1–6, girdle plates.
1^p posterior intercalary.
1^c, posterior intercalary plate.
1⁗, antapical.
?, anterior intercalary plate or apical 3′ (?).
ant. pl., anterior plate of ventral area.
att. area, attachment area.
int. pls., intermediate plates of same.
n., nucleus.
post. pl., posterior plate of same.
v. a., ventral area.
v. po., ventral pore.
fl. po., flagellar pore.
cl. po., closing platelet of apex.
cyt., cytoplasm.
f., fin.
st. gr., starch granules.
th., theca.

PLATE **1**.

Fig. 1. Ventral view of chain of *Gonyaulax series*, sp. nov. × 1120.
Fig. 2. Dorsal view of same. × 1120.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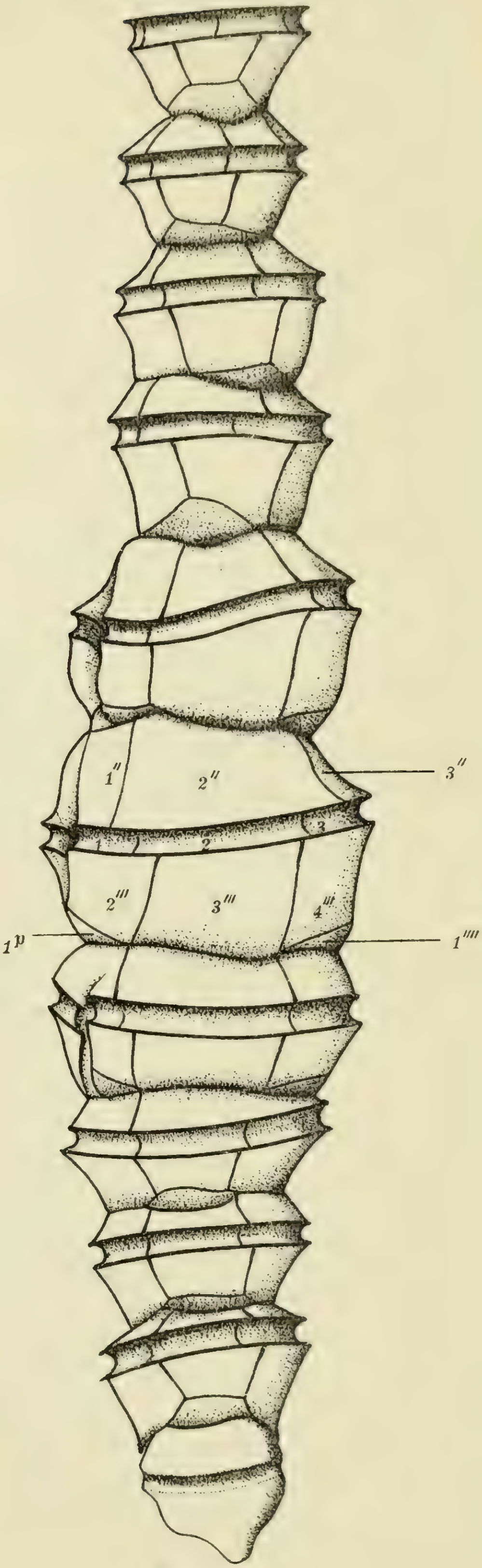
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HELIOTYPE CO BOSTON

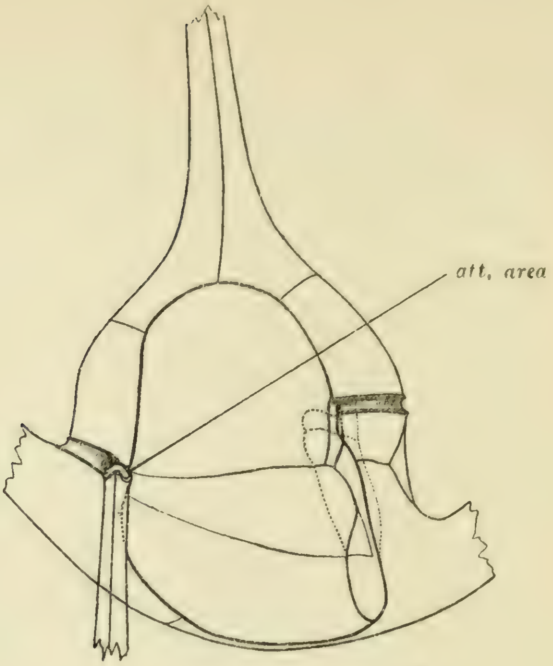
PLATE **2**.

Fig. 3. Cell contents of chain of *Gonyaulax series*, sp. nov. × 1120.

Fig. 4. Midventral view of 5th to 7th members of the chain. × 1400.

Fig. 5. Ventral view of chain of two individuals of *Gonyaulax catenata* (Levander). After Levander (1894). × 780.

Fig. 6. Ventral view of parts of two individuals of *Ceratium bucephalum* in chain showing structure of the ventral region and method of attachment in chain. × 700.



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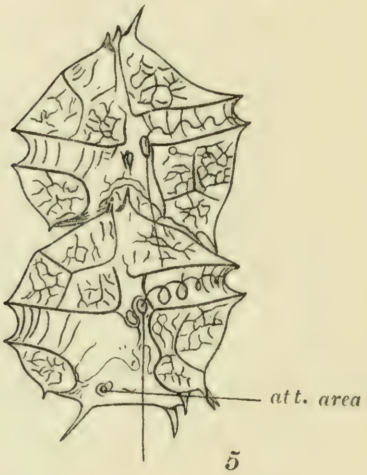

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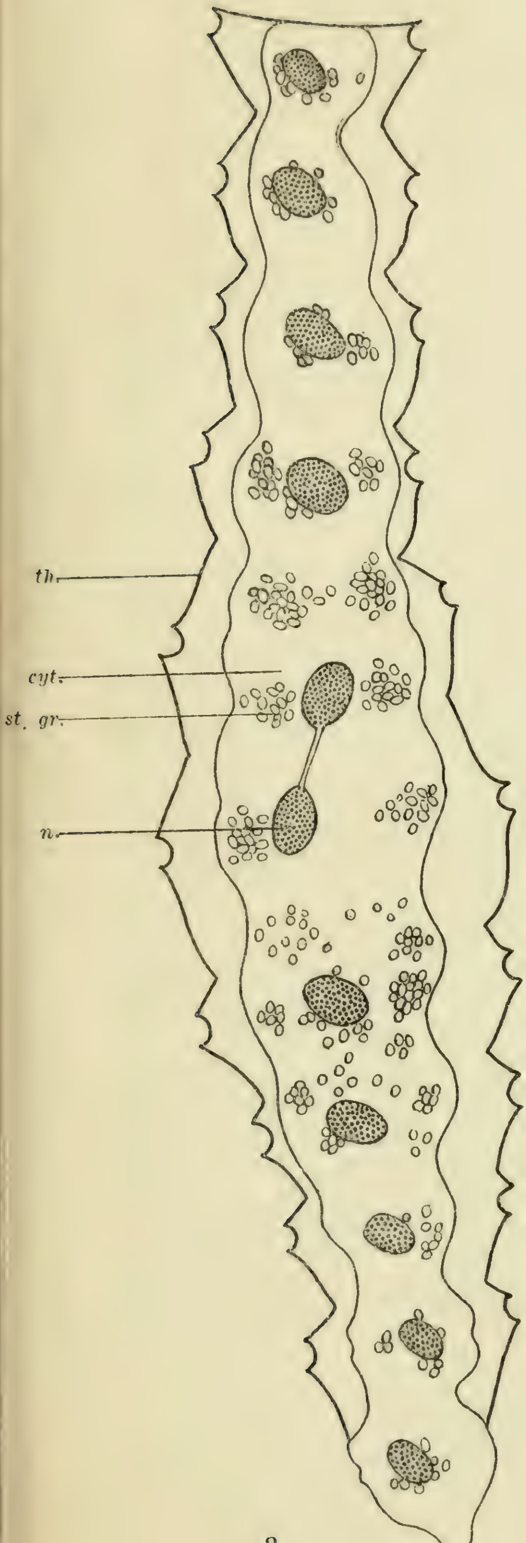
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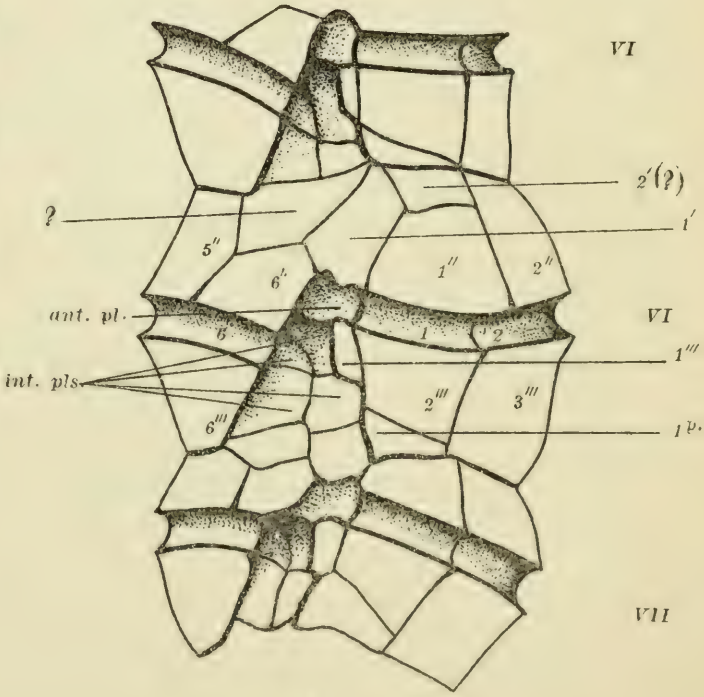
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4

HELIOTYPE CO., BOSTON

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
Vol. LIV. No. 11.

TWO NEW SPECIES OF ASCODIPTERON.

By Frederick Muir.

With Three Plates.

CAMBRIDGE, MASS., U. S. A.:
PRINTED FOR THE MUSEUM.
April, 1912.

No. 11.— *Two new species of Ascodipteron.*

By Frederic Muir.

One rainy evening in July, 1908, when sitting on the veranda of the Hotel in Amboina, two bats (*Miniopterus schreibersi*) came flying round after the insects attracted by the light and shelter. Wishing to procure specimens of Nycteribiidae I caught them in my insect net. Upon examining them I observed a Streblid (*Nycteribosca amboinensis* Rnd.), crawling over their bodies in great numbers, and turning back the long fur around the head, I found at the base of the ear, a small swelling with a minute white body protruding from the side (Plate **1**, fig. 1). Dissected out of its host the flask-like shape of the protruding white body revealed it to be the imbedded female of a species of Ascodipteron (Plate **1**, fig. 2).

Wishing to learn more about this interesting insect, and if possible, to procure the larva and male, I told my collector to bring me as many bats as he could catch. During the course of a couple of weeks I examined over one hundred bats consisting of five or six species. I soon notice that only one species of bat (*Miniopterus schreibersi*) was attacked by the Ascodipteron, twenty-eight per cent of them being infested by this parasite. Most of the Nycteribiidae and Streblidae were also found upon the same species of bat. It is possible that the bats can scratch the Ascodipteron out as I found several with the skin broken at the base of the ear; or they may help one another to rid themselves of their parasites, as I have often seen bats resting side by side biting among their neighbor's fur.

That the several species of Pupipara infesting bats in this part of the world are not the rare insects that they are stated to be elsewhere, is shown by the following list.[1]

---

[1] *Lipoptena tolisina* and *Penicillidia progressa* are Dr. Speiser's manuscript names and will be described together with the new species of Listropodia.

Number of bats examined.		Number of parasites found.	
60	*Miniopterus schreibersi*	100	*Lipoptena tolisina* Speiser
		50	*Listropodia,* sp. nov.
		30	*Penicillidia progressa* Speiser
		180	*Nycteribosia amboinensis* Rnd.
		28	*Ascodipteron speiserianum,* sp. nov.
25	*Emballonura nigrescens*	3	*Raymondia pagodarum* Speiser
10	*Nyctinomus sp.*	5	*Lipoptena tolisina* Speiser
6	*Myotis adversus*	16	*Listropodia* sp. nov.
		12	*Nycteribosia amboinensis* Rnd.

The Ascodipteron always occupied the same position in the host, namely, under the skin at the base of the ear. Out of the seventeen bats bearing this parasite, that I examined, one had three specimens, two by one ear and one by the other, nine had two specimens and seven only one specimen.

I placed many bats, bearing these parasites, in cages but they refused to eat any of the insects I supplied them with, and died within forty-eight hours. In spite of this I was fortunate enough to procure five pupae of Ascodipteron and three of *P. progressa.*

Ascodipteron speiserianum, sp. nov.

Stated briefly the life-history of this species is as follows:— The imbedded female has the posterior portion of her abdomen protruding from the host. A single egg passes from the ovarian tube into the uterus, where it hatches in the usual pupiparous fashion, and the larva, fed by the contents of the nutriment-glands, grows to maturity. It is then ejected from the uterus and falls to the ground, where it immediately forms a puparium and pupates. The adult fly emerges in from thirty to thirty-three days and is then a perfectly normal insect, with fully developed legs and wings. A hiatus now occurs in my knowledge of the life-history, as I could not get the sexes to copulate in captivity, but I anticipate that this takes place in a normal manner whilst the female still has wings. The female then seeks her host, and by the aid of the series of chitinous blades at the end of her proboscis, cuts through the skin, she then gets rid of her legs beyond the trochanter and her wings; her abdomen enlarges and engulfs the thorax and head, so that eventually they lie at the bottom of a pit, at the anterior end of the abdomen, as if they had become invaginated. The male, at least in this species, remains external, his proboscis not having the necessary weapons to cut through the skin of the bat.

Most of the bats were caught in the Batoe Lobang, a cave situated in the hills, a few miles southwest of the town of Amboina, which in the rainy season is flooded with from six to twenty inches of water. In my breeding cage one of the fine full-grown larvae fell into some water and pupated floating on the surface. It is therefore possible that some of the larvae ejected while the cave is flooded may escape destruction.

I have named this species after Dr. Paul Speiser, the well-known authority on the Pupipara, to whom I am indebted for the identification of the Streblidae and Nycteribiidae mentioned in this paper.

The imbedded female. The presence of the parasite makes itself visible as a small swelling at the base of the ear of the bat, with a small pearly-white body protruding from one side (Plate **1**, fig. 1). Viewed under a lens of medium power the exposed end is seen to have an opening running horizontally across the top; this is the vagina or opening of the large uterus. The insect has the power of extruding or withdrawing the edges of this opening. When fully extruded a small dark spot, the opening of the rectum, is visible dorsad of the vagina. A little above this are four spiracles, the inner pair nearer the anus than the other; a pair of dark spots bearing short bristles lie between the inner spiracles and the anus. Ventrad of the vagina is another pair of spiracles. A row of small dark bristles circle the vagina in line with the spiracles, several irregular circles of similar bristles are situated a little further forward.

Dissected out of its host the parasite appears as a semitranslucent, pearly white, flask-shaped body (Plate **1**, fig. 2) from four to five millimeters long and two to three across the largest diameter; the shape and size varying according to the stage of development of the larva in the uterus. No head or thorax is visible, but the anterior end is invaginated to form a chamber in which they are situated (Plate **1**, fig. 2). Under a lens of high power the abdomen appears annulated, owing to the presence of circular body muscles just below the skin; below these circular muscles is a layer of longitudinal muscles, attached to the central part and proceeding to both ends, of the abdomen. Similar muscles, but less numerous and highly developed, are situated in the abdomen of *Nycteribosca amboinensis.*

The uterus is large and when containing a full grown larva extends more than half-way up the abdomen. There is a pair of large, short ovarian tubes, opening into the uterus by a very short oviduct. When the uterus is empty the ovarian tubes point anteriorly, but as the larva develops the uterus pushes forward and carries the base of the ovarian tubes with it so that the ovarian tubes eventually point posteriorly (Plate **1**, fig. 2, o). Muscles proceed from near the middle of the external walls of the uterus to the abdominal wall, and together with the longitudinal abdominal muscles, regulate the movements of the uterus for ejecting the full grown larva.

A pair of small glands,[1] spermathecae ? (Plate **1**, fig. 2, spr.), open at the base of the oviduct and below these, in a central position, is the short common duct of the two sets of *nutriment glands* (Plate **1**, fig. 2, *ng*). A set of these glands lie on each side of the body, each set consisting of three ducts with small, round, glandular cells, situated symmetrically along each side. The three ducts meet in a common duct before joining the opposite set of glands to form the common opening. These glands reach to the anterior walls of the abdomen and then turn back. *Cyclopodia albertisi* and *Nycteribosca amboinensis* show a similar condition except that the glandular cells are bunched together at the end of the nutriment ducts. In all the specimens of Pupipara that I have examined one of the ovarian tubes is always small and apparently not functional. The nutriment glands appear to be modified colleterial glands.

This form of female genital organs is common to the Pupipara and several species of viviparous Muscidae (*sens. lat.*) *i. e.* the genus Glossina, *Dyscritomyia hawaiiensis* and several Malayan species I have not yet identified. Among the Tachinidae some of the oviparous and viviparous species have greatly enlarged uteri, but, so far as I know, none have the pair of simple ovarian tubes. *Dyscritomyia hawaiiensis* carries the young larva about in the uterus for many days before depositing it, but the larva does not appear to increase in size while in the uterus.[2]

The stomach, beyond the thorax, is long and thick, the intestine long and thin, slightly enlarged in the rectum. There are two Malpighian tubes (one pair) joined together and entering the intestine by a common stalk. I can trace no "rectal glands." Both *Cyclopodia albertisi* and *Nycteribosca amboinensis* have two pair of Malpighian tubes and four "rectal glands."

The abdominal tracheae just behind the spiracles are large, but soon break up into smaller tubes. Those leading from the ventral spiracles do not appear to join one another, or to be in communication with the dorsal ones, but each sends off two or three longitudinal branches. The four dorsal ones join and form a reticulation a little beyond the spiracles, then continue as four main longitudinal branches, which proceed to the various organs of the body and send off small branches to the muscles. I can trace no other spiracles in the abdomen. In the thorax there is a large spiracle in the episternum and a small and very obscure one near the halteres I could not follow the connection between the abdominal and thoracic tracheae through the small abdominal foramen.

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[1] Only one is shown in the figure.

[2] I am indebted to Mr. F. Terry for information about this species.

The head and thorax can be moved forward and backward so that the end of the proboscis can be thrust out of the mouth of the invagination. They are greatly distended and appear as one, owing to the large occipital foramen and the distention of the membranes (Plate **1**, figs. 3, 4). The various sclerites are isolated, often partly concealed by the distended membranes overlapping their edges, especially between the gena and the front and face. The basal stumps of the wings are present (Plate **1**, fig. 3, *w*), the halteres are large and intact (Plate **1**, fig. 4, *h*) the legs are missing beyond the trochanter (Plate **1**, fig. 4, *t*). The most conspicuous part of the head is the large thick proboscis (Plate **1**, fig. 3, *p*) which projects forward, bearing fourteen sets of chitinous blades at the end. This proboscis is unique among flies, but I hope to show that it is a modification of a normal muscid type developing along certain lines indicated in certain other species of Pupipara.

The larva. The full-grown larva is about 1.5 mm. long and 1 mm. across the largest diameter, oval, semitranslucent and pearly white (Plate **1**, fig. 5). On the posterior end there are four curved, chitinous ridges, the spiracles, which under a lens of high power appear serrated; the dorsal is longer than the ventral pair. Between the anterior ends of the ventral pair is a small dark spot, the anal mark. At the anterior end, in a slightly ventral position, is a small opening leading to the stomach; no mouth-hooks are present.

Upon examining the larva in certain lights the tracheae can be distinctly seen (Plate **1**, fig. 5). The spiracles on each side give off large tracheae which meet and continue to the anterior end, giving off ten dorsal and ten ventral branches. The first dorsal branch, counting from the spiracles, runs backward and does not coalesce with its fellow on the other side; the following six coalesce with those on the opposite side, while the three anterior ones do not. The first ventral branch runs backward and, along with the following five, which join one another, does not unite with the corresponding branch on the opposite side; the anterior four appear to unite with those on the opposite side. Small branches ramify among the body muscles and their ends often appear to anastomose.

The spiracles of the larvae of Pupipara afford good characters by their position, size, etc.

As little is known about them I describe several. These descriptions refer to the adult larvae taken from the uteri, for in the Nycteribiidae the larvae change their shape immediately they pass out of the uteri.

The larvae of *Lipoptena tolisina* Speiser (Plate 2, fig. 6) is oval, about 1.27 mm. long and .72 mm. along the largest diameter, with the posterior end slightly pointed; at the anterior end there is a small constricted portion, across which is an opening leading to the stomach. There are two pair of spiracles, the anterior situated in a dorso-lateral position, about the middle, the posterior near together at the end of the body, standing slightly above the surface.

The larva of Listropodia sp. nov. (Plate 2, fig. 7) is about 1.27 mm. long and .8 mm. along the largest diameter, ovoid, thicker anteriorly, a small constricted portion indicates the anterior end, with the opening into the stomach across the top. The anterior pair of spiracles is situated in a dorso-lateral position, slightly behind the middle line, the posterior pair is situated at the end of the body and does not stand above the surface of the body.

The larva of *Penicillidia progressa* Speiser (Plate 2, fig. 8) is about 1.6 mm. by 1.2 mm., ovoid, the posterior end being the thicker. The anterior end bears a small head constriction, with the entrance to the stomach. The spiracles are in nearly the same position as Listropodia, sp. nov.

In *Cyclopodia albertisi* the larva is very similar to that of *P. progressa*, but the spiracles, situated in nearly the same position, are very light in color and difficult to see.

The larva of *Nycteribosa amboinensis* (Plate 2, fig. 9, *a b*) is about 1.5 mm. by 1.2 mm., an irregular ovoid, distended on the ventral side, sometimes to a great extent, and slightly flattened dorsally; the anterior end is bluntly pointed, but does not bear a constricted headpiece. The anterior spiracles are situated a little less than a third from the end and are far apart; their outline crescent-shaped, the posterior spiracles are near together, on the bluntly pointed posterior extremity, one slightly dorsad of the other, not symmetrically side by side; they stand out from the body wall and their outline is round.

The position of all these larvae in the uterus is similar, the anterior constricted portion, bearing the mouth, being in contact with the opening of the "nutriment" gland. The appearance of the contents of these glands and the contents of the stomach are the same under a lens of high power, and they have a similar chemical reaction.

The puparium. The full-grown larva is ejected from the uterus, falls to the ground and pupates where it falls. At first pearly white, it soon turns yellow, and in about an hour hardens to a dark brown puparium, of similar size and shape to the larva. No anterior spiracles, or "horns," appear, but the thoracic tracheae of the pupa are attached to two spots on the operculum, in a similar position to the anterior pupal "horns" common to many of the Cyclorrhapha. The operculum is large, the posterior margin running in a curve across the dorsal surface, about one third down, and continuing in a curve to the anterior edge, where it is slightly emarginate. There is no line of dehiscence running ventrically.

The position of the head of the male pupa is normal, but its small size compared to the great operculum would suggest a ptilinum being of little use. In the female the enormous labium is bent under and rests on the sternum, a position it cannot take up when hatched and hardened. Part of the notum and the face and frons are brought in contact with the inner surface of the operculum, and it appears to be the distention of the membrane, especially between the gena and face and frons, that forces it off. The pupa state lasts about thirty days.

The puparia of the two species of Nycteribiidae that I know differ very considerably from that of Ascodipteron. In *P. progressa* the full-grown larva, when passing out of the uterus, becomes greatly flattened, especially on the ventral surface, and is held by its anterior end for a short time between the external flaps of the vagina, its ventral surface being pressed against the skin of its host, generally near the junction of the wing-membrane with the body or limb. The chitinous exudation that covers the soft larval skin, to form the puparium, first appears along the edges of the flattened ventral surface and fastens it to its host, then covers the dorsal surface, but does not appear on the ventral side, that side remaining a soft membrane through which, if carefully detached from the host, the pupa can be seen developing. The larval spiracles remain distinct and stand up above the surface. No anterior pupal spiracles, or "horns" appear, but the pupal thoracic tracheae are attached to two spots on the inner surface of the operculum, and can be faintly discerned externally. The operculum is large, the posterior edge curving across the dorsal surface near the middle, slightly in front of the anterior spiracles, and continuing along the sides to the front; no line of dehiscence runs towards the ventral surface. The position of the head of the pupa would prevent the use of a ptilinum, as the legs are folded over the head and thorax, the femoratibial joints meeting in the middle line (Plate **2**, fig. 10). A movement of the legs would force off the operculum.

The puparium of *L. tolisina* is flattened and fastened to the host as in *P. progressa.*

The winged female. After from thirty to thirty-three days in the pupal state, the imago makes its appearance fully winged and with perfect legs (Plate **2**, fig. 12, *a*). It is of a uniform light reddish brown color, 1.6 mm. long with large rounded wings 2 mm. long. The costal vein ends slightly beyond the third vein and bears short bristles; auxiliary vein absent; first vein strong, evenly and slightly curved, joining costal slightly before middle, bearing few bristles; second vein stout until junction of third vein, then thins off, joining costal slightly beyond middle; third vein strong, arising from near base of second, joining costal slightly before its end, bears few bristles; an exceedingly weak branch, indicated by a fold in the wing, arises near its centre and reaches the margin a little beyond the apex; fourth vein stout at its base, thinning out beyond the cross-vein; fifth vein appears as fold in the wing; cross-vein very oblique, appearing as base of vein three (Plate **2**, fig. 11, *c. v.*). The legs are fairly long, tibiae slightly curved outwardly, metatarsus as long as the following three joints together; claws simple, empodium large, and bearing hairs somewhat like the onychium of Rhipiceridae. Front legs well separated from the hind pair, with coxae far apart; coxae of third pair nearly meeting in the central line; legs covered with short hairs but no special bristles. Thorax large, slightly compressed laterally, distinctly deeper than broad; notum moderately convex; scutellum small. The sclerites are covered with short hairs, and are well separated by the connecting membrane.

Owing to the enormous size of the proboscis, the distention of the membrane between gena (Plate **2**, fig. 12, *g*) and frons and face and to the large occipital foramen, the head and thorax appear as one piece. The face and front form one piece detached from the gena, and whatever other sclerites the head may possess, it continues in the same curve as the notum. A pair of large sclerites form the sides of the head (Plate **2**, fig. 12, *g*) and meet beneath. The proboscis is a chitinous, broad, dorso-laterally flattened, blunt cone, with a base somewhat wider than the head or notum, and about half as deep as wide, rounded off bluntly at the end. This forms the outer tube through which a smaller inner tube runs, the two being connected by a membrane, at the apex. Arising from this membrane, and radiating from the inner tube, are fourteen rows of chitinous blades. Dorsally there are six rows, the inner blades being long, narrow and curved slightly forward and sidewards at the tips; the outer blades being shorter and curved backward (Plate **2**, fig. 13); ventrally there are four rows, their blades being short, broad and curved backward (Plate **2**, fig. 14). The anterior edge of the outer tube is not even, but runs back laterally, thus leaving a large membraneous surface at the sides in which the two rows of large broad blades (Plate **2**, fig. 15) are set. By drawing back the inner tube all the blades are drawn into the outer tube and become in great part concealed, as they generally are in living specimens. The curved, hooked dorsal blades are evidently used to drag the insect into the wound cut by the ventral and large lateral blades, as they could not be used as cutting blades. The proboscis has a slight range of vertical movement on its point of juncture with the head, but it could not be used to sever its wings and legs. The antennal pits are narrow, transverse slits, through which the ends of the antennae project. The antennae are two-jointed, the second joint round, with a finely branched arista. Maxillary palpi and eyes missing.

The abdomen is membraneous, whitish, basal two thirds covered with very fine irregular bristles; the distal third, exposed in the imbedded female, bears longer and darker bristles. The method by which, and time when, the female gets rid of her legs and wings I could not discover, nor could I get the sexes to pair in captivity. I found no trace of legs or wings in the cavity formed under the skin of the bat, so that they must be discarded before she becomes fully-imbedded. It is probable that the growth of the abdomen over the thorax and head is rapid, as I found but one specimen which was only partly so covered.

The male. Head small, covered with short bristles; notum overlapping the vertex; occipital foramen large, but much smaller than in the female; eyes absent; antennal pits large, taking up the greater portion of the anterior part of the head; antennae two jointed, first cup-shaped, bearing large bristles, second round, bearing a stout arista with bifurcated end, covered with branched hairs, anterior part studded with "sense pits." Front rounded, face receding, gena (?) (Plate **2**, fig. 12b, *g*.) large; proboscis bulbous, broad, short, projecting anteriorly, with minute tip, set far back under the head (Plate **2**, fig.

12b, *p*); maxillary palpi small, spatulate, arising from the small oral membrane (Plate **2**, fig. 12b, mp.).

Wings, legs, and thorax as in the female, except that the male thorax has a much smaller foramen and the sclerites are more compact.

Abdomen pointed, membraneous, whitish, covered with small bristles, no definite segmentation. Posterior portion pointed and chitinous, forming the genitalia, which is on the same plan as *Nycteribosca amboinensis* (Plate **2**, fig. 18). The penis is a long flattened tube, with chitinous sides, articulated to a thin chitinous basal lever, for the attachment of muscles (Plate **2**, fig. 18, *p*). The penis-guide is a curved, thin, long sclerite, expanded at the end into two pointed flaps, which turn up dorsally and unite above, thus forming a short tube through which the penis passes (Plate **2**, fig. 18, *p. g.*); below the penis-guide is another pair of flaps with three short, stout chitinous bristles at the end.

HOMOLOGIES OF THE FEMALE TROPHI. *The oral membrane.* The proboscis of the female differs so greatly from that of the male, and from any other fly known to me, that a comparison with some allied forms may be of interest. I have taken Dr. G. Dimmock's [1] interpretation of the trophi, which, in its main features, is the same as Dr. H. J. Hansen's.[2] I can follow neither Prof. J. B. Smith[3] nor Mr. W. Wesché [4] in theirs.

In the more generalized mandibulate insects a suture marks the division between the head-capsule and the labium, maxillae, and clypeus, and between the clypeus and labrum. In the majority of Diptera these sutures are greatly increased and form a connecting membrane, which I shall call the *oral membrane.* In the Nematocera it is not greatly developed, in some of the Brachycera (*i. e.* Bombyliidae) it is large, but it is among the Cyclorrhapha that it reaches its greatest development. In many of the Calyptratae it forms a large membraneous cone, on the apex of which the labrum and labium are situated. If the muscles controlling the pharynx of Hippobosca be cut, the proboscis can be drawn out and is then seen to be situated on a membraneous cone; when the proboscis is drawn right in the cone is invaginated (Plate **2**, **3**, figs. 19–20, *om*). In Haematobia and Glossina we can see the intermediate forms between the muscid and hippoboscid types (Plate **3**, fig. 21). In *Cyclopodia albertisi* and *Nycteribosca amboinensis* (Plate **3**, figs. 22–23) the proboscis is situated far back under the head, and has but a limited movement; the dorsal part of the oral membrane forms the anterior part of the head, from which the oral membrane stretches back to the base of the proboscis (Plate **3**, figs. 22–23, *om*). The same condition is found in the male of *Ascodipteron speiserianum.* In the female it is difficult to distinguish the oral membrane, on account of the great expansion of the head, but it must be the membrane between the face and gena and the proboscis. The great expanse of oral membrane in the Muscids is mostly due to the reduction of the clypeus and maxillae.

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[1] The anatomy of the mouth-parts of the sucking apparatus of some Diptera. 1881.

[2] Dipterernes Mundale. 1883.

[3] Contribution toward a knowledge of the mouth-parts of the Diptera. Trans. Amer. Ent. Soc., 1890, **17**.

[4] The mouth-parts of the Nemocera. Journ. Roy. Micr. Soc. 1904, and later works.

The pharynx. The pharynx is the anterior part of the oesophagus, highly chitinized, flattened dorso-ventrally, the lateral edges being turned up to form the *dorsal arms* (Plate **3**, figs. 20–30, *da.*). This forms the fulcrum of many entomologists. In many of the Orthorrhapha (*i. e.* Culicidae, Bibionidae, Dolichopidae) the dorsal arms are attached to the clypeus, which has little or no movement. This type can be called the "fixed" pharynx. In some of the Orthorrhapha (*i. e.* Asilidae) the lateral edges of the pharynx are turned up slightly but are not prolonged into dorsal arms and are not attached to the clypeus; the pharynx is then "free." In the "protrusile" type (*i. e.* Syrphidae, Muscidae) the clypeus is reduced to a small strip, or to two or one small sclerites, situated in the oral membrane, to which the dorsal arms are attached, or the clypeus is entirely lost and the dorsal arms meet together in a point situated on the oral membrane. In the "fixed" and "free" types the pharyngeal muscles are attached to the clypeus, but when this is greatly reduced, or absent, as in the "protrusile" type, the pharyngeal muscles are attached to the inner sides of the dorsal arms.

In those protrusile types which are capable of the greatest amount of movement, the basal part of the pharynx is prolonged into two long "basal arms" for the attachment of the extensor and retractor muscles.

The mechanism for the movement of the protrusile pharynx appears to be of a simple nature, as shown in Plate **3**, fig. 24. The pharynx, *a, b, c,* is attached to the oral membrane at the point, *a,* on which it can turn in a vertical direction; the retractor muscle is attached to the point *c* and to the back of the head-capsule and the extensor to the point *c* and to the head capsule near the oral margin. Upon the contraction of the extensor muscle the point *b* moves through the arc to *b*1, *a* being the centre of the circle.

The pharynx of Hippobosca is of the protrusile type, but greatly modified, probably owing to the flattening of the head and its position on the thorax. The dorsal arms are large, the posterior ones reduced; the anterior half of the pharynx is in the form of a thin, flattened, highly chitinized, and elastic tube. A powerful extensor muscle runs from the end of the dorsal arm to the base of the proboscis (Plate **3**, fig. 25); the stipites are articulated to the base of the labrum and attached to the pharynx by muscles and form the radii of the arc (Plate **3**, fig. 25, *b*, *b*) along which the proboscis travels when the extensor muscle is contracted. The retraction is brought about by a muscle proceeding from the base of the proboscis to the head capsule. This is the chief movement made by the insect when feeding, but the pharynx can be turned upon the point *d* as in other Calyptratae.

In Streblidae and Nycteribiidae, owing to the shape of the head, the proboscis is drawn back under the head (Plate **3**, figs. 22, 23) and the pharynx has a very limited movement. Hippobosca with the proboscis retracted (Plate **3**, fig. 20) and the head capsule around the lower part of the oral margin cut away, would represent the position of affairs in these two families. In the female *Ascodipteron speiserianum* the pharynx is of the normal streblid type, but the dorsal arms (Plate **3**, fig. 30, *da*) appear to be fixed to the edge of the head-capsule and to have no power of movement. The enormous size of the proboscis would prevent the small pharynx from moving it. The male pharynx I have not been able to examine, but the head is so similar to Nycteribosca that there can be little difference in the pharynx.

The maxillac. The maxilla of Diptera has undergone a great amount of reduction. It is found in its least reduced state in the Orthorrhapha, where there is a distinct basal part, the stipes, a free distal piece, the palpifer,[1] and a maxillary palpus. In some families the papifer is lost and the distal end of the stipes is attached to the labium (*i. e.* Empididae, Pipunculidae) to the labella (*i. e.* Dolichopidae) or to the base of the labrum (*i. e.* Muscidae). In all the Syrphidae that I have examined there is a free palpifer and in the few Conopidae I know it is absent and the stipes is attached to the base of the labrum. In some of the Acalyptratae (*i. e.* Drosophilidae) there is a free palpifer, in others it is absent and the stipes are attached to the base of the labrum, a condition found in all the Calyptratae, Hippoboscidae, Streblidae and Nycteribiidae. According to Müggenburg, Braula has a free palpifer, which is one of the reasons I cannot place it with the last three families. In some muscids (*i. e. Musca domestica*) a small protuberance, with a few hairs attached to it, indicates the position of a rudimentary palpifer.

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[1] I use this term after Prof. J. B. Smith, it is the lacinia of Wasché, the lobus maxillae of Hansen and the scalpellum of Meinert.

That the palpi in Diptera are maxillary is easily demonstrated by following them through such families as Asilidae, Bombyliidae, and Syrphidae.[1] In the Schizophora they arise from the oral membrane, owing to the reduction of the maxillae, and have only a slight muscular connection with the stipites; in a few species they are absent and a small sclerite indicates their position. In those genera in which the trophi are abortive the palpi are also absent.

The maxillary palpi are large in most of the Pupipara, although they have often been described as absent. In Glossina (Plate **3**, fig. 21, *mp.*) they arise from the oral membrane, near the base of the proboscis, the distal two thirds meeting together to form a cover for the distal part of the proboscis. In Hippobosca (Plate **3**, fig. 20, *mp.*). They arise from the oral membrane, near its attachment to the head-capsule and meet together to form a cover for the distal portion of the proboscis. In Nycteribiidae, Streblidae and the male Ascodipteron they arise from the oral membrane near the anterior (or dorsal) edge of the oral margin and cannot cover the proboscis (Plate **3**, figs. 22, 23, *mp.*). In the female *A. speiserianum* the stipites are attached to the base of the labrum, as in the Streblidae; there are no traces of palpi.

The labrum and labium. Of all the trophi of the female *A. speiserianum* it is the labium that has undergone the greatest specialization, and offers the greatest interest. In the Calyptratae the proboscis generally takes the form of a tube, in which the hypopharynx lies, the ventral, and major, part of the tube being formed by the labium, the dorsal part by the labrum-epipharynx. The labium is composed of two large sclerites, the *dorsal* and *ventral plates,* joined together by the *lateral membranes* (Plate **3**, figs. 27–32, *dp, vp, lm*). The dorsal plate is longitudinally grooved on its dorsal surface, or, to describe it more accurately, its lateral edges are curved up dorsally. The ventral plate also has its lateral edges curved up dorsally, sometimes so greatly that they fold round and partly envelop the dorsal plate (Plate **3**, figs. 28–29, *dp. vp.*) In *Glossina palpalis* the proboscis is similar to that of Melophagus but the differentiation of the globular basal and their distal portion is not so marked.

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[1] I cannot follow Mr. Wasché in his arbitary method of calling the palpi maxillary or labial. His "law" does not hold good, as in some cases, where reduction of the maxillary has left the palpi isolated on the oral membrane, they still have a muscular connection with the stipites.

In the Nycteribiida, Streblidae, and male Ascodipteron the proboscis is drawn back under the head and has little power of movement. In the two latter the basal part is large, the dorsal plate of the labium is sunk slightly beneath the edges of the ventral plate. These characters are seen well in *A. amboinensis* (Plate **3**, figs. 28–29, *vp. dp.*) in which the labrum-epipharynx is short and broad and bears several large sense-pits (Plate **3**, figs. 26–28, *le.*). The lateral edges of the dorsal plate of the labium, beyond the labrum, overlap and so form a tube (Plate **3**, fig. 29, *dp.*). The ventral plate is large and enfolds the dorsal plate, which, in a dorsal view, is covered by the lateral membranes (Plate **3**, figs. 26, 29, *vp. dp. lm.*). In the female *A. speiserianum* the labrum-epipharynx is short and broad, with several large sense-pits. The basal part of the dorsal plate of the labium is Y shape in section (Plate **3**, fig. 31, *dp.*), beyond the apex of the labrum the lateral edges coalesce, the keel beneath becomes reduced and the dorsal plate forms a complete tube in which the hypopharynx lies (Plate **3**, fig. 32, *hp. dp.*). The lateral edges of the ventral plate also meet and coalesce, except a small basal portion (Plate **1**, fig. 3, *le*, Plate **3**, 30–31, *lm.*) from which the greatly reduced lateral membranes stretch down to the edges of the dorsal plate where they are in contact with the short labrum (before they coalesce to form a tube (Plate **3**, fig. 31, *lm.*). Thus the dorsal plate, beyond the labrum, forms a complete inner tube and the ventral plate a complete outer tube.

The apex of the proboscis of flies is developed into a pair of organs, the labellae, whose homologies are very uncertain and whose development in the various families differs greatly. In most of the Cyclorrhapha they are usually well developed, lobe-like and membraneous, capable of being brought together and folded away, or distended and divaricated; they form the connection between the distal ends of the dorsal and ventral plates and for our present purpose, may be regarded as the distal development of the lateral membrane. Across the surface of these organs radiate rows of incomplete taenidae, the pseudotracheae, which undergo various modifications in different families. In some of the Phoridae they are in the form of the letter U, the prongs being pointed and turned outwards, and their bases fastened to the membrane, along the inner surface are strong, two-pronged, chitinous teeth. In a small Javanese scatomyazid there are several large, strong, pointed teeth on the inner edge of the labellae, with which it impales small insects. Among the Borboridae I find *Limosina venalicia* with eight rows of small curved chitinous teeth, radiating across the labellae. In most of the blood-sucking flies the labellae are reduced in size, but furnished with formidable stout chitinous teeth, very similar to those in Phoridae. The tip of the proboscis of *Melophagus ovinus* is set round with short, stout points. *Hippobosca equinus* has stout bluntly pointed teeth. In *Cyclopodia albertisi* the teeth are small. In *Nycteribosca amboinensis* there are several rows of small chitinous teeth, radiating from the apex of the dorsal plate of the labium to the apex of the ventral plates, across the connecting membrane (Plate **3**, fig. 26, 27) which can only be seen when the dorsal plate is thrust beyond the ventral plate. The male *Ascodipteron speiserianum* has similar, but exceedingly small, teeth. In the female of the same species these teeth are developed into fourteen series of "blades" (Plate **1**, figs. 3, 4, Plate **2**, figs. 12–16). Abnormal as this proboscis is, yet it is only a modification of the streblid type.

The hypopharynx is very similar in all the Pupipara and forms a tube along which the saliva flows.

CONCLUSIONS.

The male of *Ascodipteron speiserianum* is a normal pupiparous fly, in habits, structure, and development so similar to the Streblidae that it is difficult to separate it from that family. The female has undergone certain modifications — specializations to meet her endoparasitic life — which must not be taken into consideration when classifying this genus. Her preimaginal metamorphosis is normal, but, when once imbedded, she undergoes a great amount of imaginal growth, which can only be compared to the growth of the abdomen of the female termite and Sarcopsylla, accompanied by a great enlargement of many of the glands of the body — *i. e.*, the salivary and nutriment glands, and by a great development of many of the abdominal muscles. The development of this fly has nothing in common with the females of the Strepsiptera.

The Pupipara I consider as polyphyletic branches of the Muscidae, the great enlargement of the uterus, necessitated by their pupiparous habit, compelling a great change in the male genitalia. Bearing this in mind I see no reason why Stomoxys and Glossina should not be placed near one another.[1] Braula I have not studied, but judging from Müggenburg's description and figures, I consider it has no place among the other families included in the Pupipara, but is near Thaumatoxena, as stated by Carl Borner.

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[1] Wasché uses the difference of their genitalia to disprove any near relationship.

The homologies of the head of the female were worked out in Amboina before I had seen Adensamer's or Monticelli's papers. The former describes *Ascodipteron phyllorhinae* as having a thin rostrum and large maxillary palpi. *Ascodipteron tabulatum* is described by Monticelli as having the proboscis formed by the maxillary palpi. If this be correct then *A. speiserianum* differs fundamentally in the anatomy of its proboscis.

Ascodipteron australiansi, sp. nov.

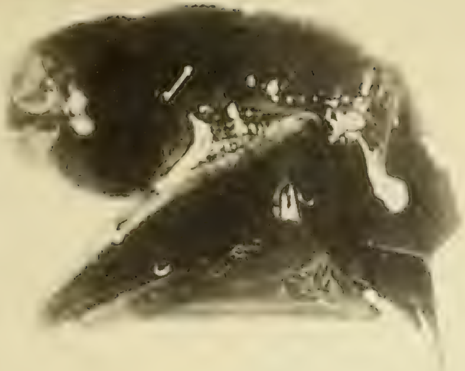
This species from the Mossman district of North Queensland is very closely allied to *A. speiserianum* and like it occupied the same position at the base of the ear of *Miniopterus schreibersi.* The single imbedded female that I procured differs from *A. speiserianum* in the following points:— Head and thorax smaller and darker, notum more convex and hairy, spines round, the exposed posterior part of the abdomen stouter and shorter. The larva, of which there was a full-grown specimen in the uterus, has the spiracles in slightly different positions, being much nearer together than in *A. speiserianum* (Plate 2, fig. 17, *a.b.*, *c.d.*).

My thanks are due to Dr. David Sharp and Mr. Hugh Scott for reference to literature and other information while in the Malay Islands, to Dr. Paul Speiser for naming my Nycteribiidae and Streblidae and to Dr. F. S. Monticelli for his paper on *A. lophotes*; also to Mr. Oldfield Thomas for identifying the bats.

The figures are free-hand drawings of the objects as seen through the microscope and may not always be in correct proportions, except Fig. 3, 4, 11, and 17 which are in proportion. Figs. 3 and 4 were kindly drawn by Mr. W. R. Potton, but unfortunately he had only shrunken spirit specimens.

PLATE 1.

1. *Miniopterus schreibersi* with two specimens of *Ascodipteron speiserianum* at base of ear. (From a photograph.)
2. Diagrammatic sketch of section through imbedded female of *A. speiserianum*. *h. t.* head and thorax; *l.* fully grown larva in uterus; *ng.* duct of nutriment glands; *o.* egg in ovarian tube; *r.* rectum; *s.* spiracle of larva; *spr.* spermathecae?; *v.* vagina.
3. Dorsal view of head and thorax of imbedded female of *A. speiserianum*. *le.* labrum-epipharynx; *p.* proboscis; *w.* stamp of wing.
4. Ventral view of head and thorax of imbedded female of *A. speiserianum*. *h.* halteres; *p.* proboscis; *t.* coxa.
5. Lateral view of larva of *A. speiserianum*.



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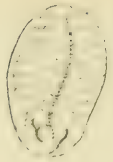

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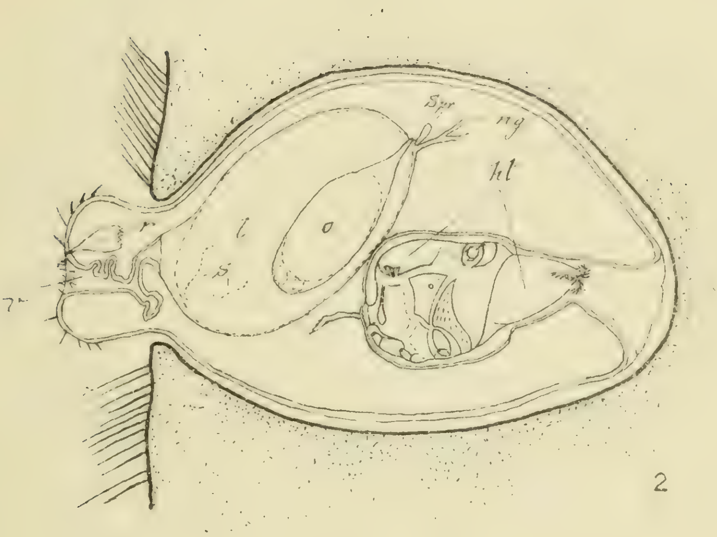
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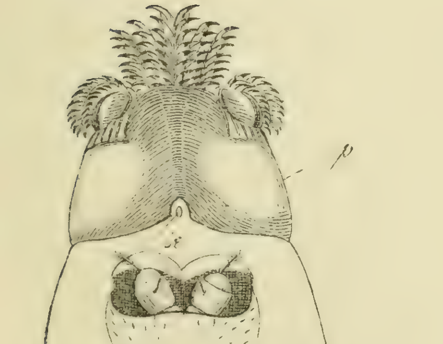

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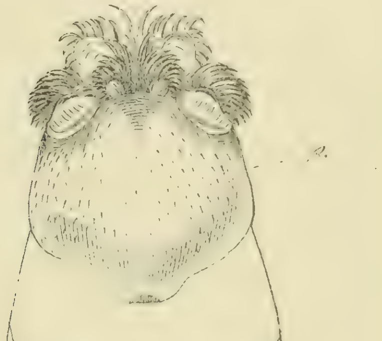

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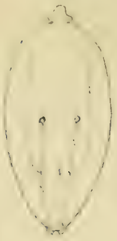
HELIOTYPE CO. BOSTON

PLATE 2.

Fig. 6. Dorsal view of larva of *Lipoptena tolisina.*
Fig. 7. Dorsal view of larva of *Listropodia* sp. nov.
Fig. 8. Dorsal view of larva of *Penicillidia progressa.*
Fig. 9. Larva of *Nycteribosca amboinensis. a.* dorsal view; *b.* lateral view, dotted line shows the shape that the ventral surface sometimes assumes.
Fig. 10. Dorsal view of pupa of *P. progressa.*
Fig. 11. Wing of *Ascodipteron speiserianum.*
Fig. 12. Lateral view of *A. speiserianum. a.* female; *b.* male; *g.* gena; *mp.* maxillary palpi; *p.* proboscis; *s.* spiracle.
Fig. 13. One of the six dorsal series of "blades."
Fig. 14. One of the four ventral series of "blades."
Fig. 15. One of the four lateral series of "blades."
Fig. 16. A "blade" from one of the lateral series.
Fig. 17. Spiracles. *a.* posterior view, *b.* lateral view of *Ascodipteron australiansi*; *c.* posterior view, *d.* lateral view of *A. speiserianum.*
Fig. 18. Lateral view of end of abdomen of a male of *A. speiserianum. e.j.* ejectulatory duct; *p.* penis; *pg.* penis-guide.
Fig. 19. Diagrammatic sketch of extended proboscis and part of head of Hippobosca. *hc.* head-capsule; *mp.* maxillary palpus; *o. m.* oral membrane; *v. p.* ventral plate of labium.



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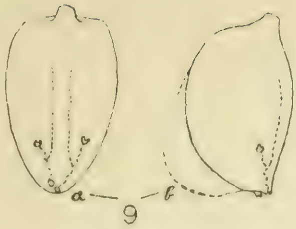

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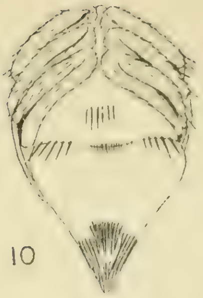

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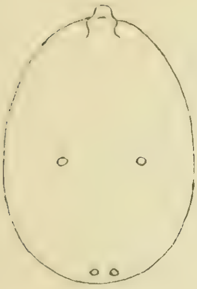

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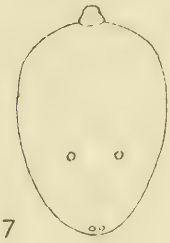

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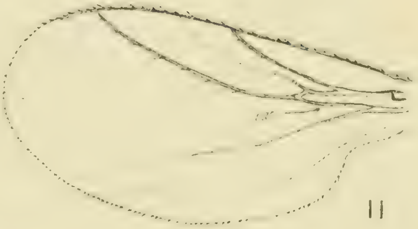

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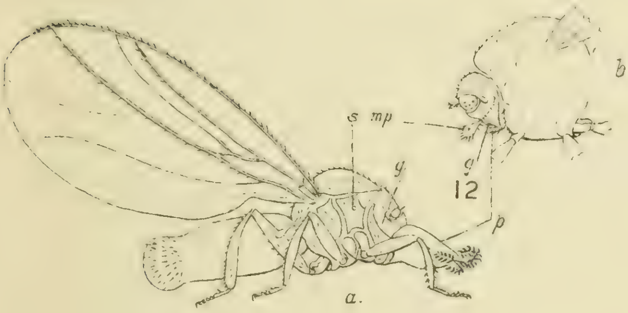

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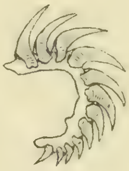

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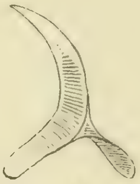

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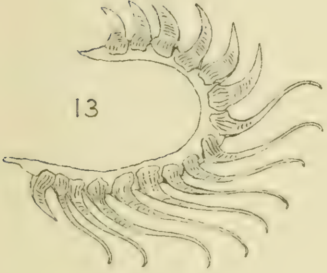

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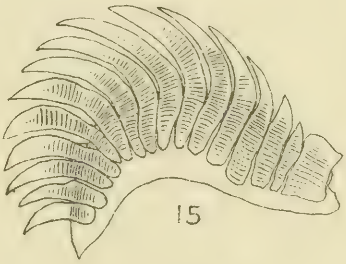

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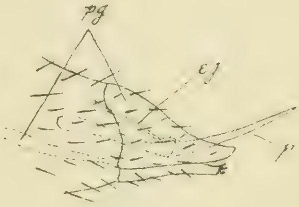

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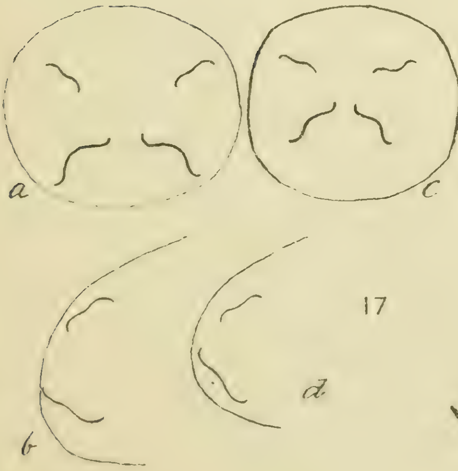

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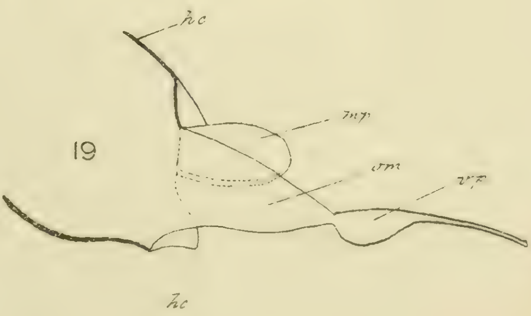

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HELIOTYPE CO. BOSTON

PLATE 3.

Fig. 20. Diagrammatic section through head of *Hippobosca equinus*. *da*. dorsal arm of pharynx; *dph*. dorsal wall of pharynx; *fl*. frontal lunule; *hc*. head-capsule; *mp*. maxillary palpus; *oes*. oesophagus; *om*. oral membrane; *sr*. salivary ducts; *st*. stipes; *vp*. ventral plate of labium; *vph*. ventral wall of pharynx.

Fig. 21. Diagrammatic section through head of *Glossina palpalis*. *ant*. antennae. Other lettering as in Fig. 20.

Fig. 22. Diagrammatic section through head of *Nycteribosca amboinensis*. Lettering as in Fig. 20.

Fig. 23. Diagrammatic section through head of *Cyclopodia albertisis*. Lettering as in Fig. 20.

Fig. 24. Diagram of extension of muscid pharynx.

Fig. 25. Diagram of extension of hippoboscid pharynx.

Fig. 26. Dorsal view of labium and labrum-epipharnyx of *N. amboinensis*, slightly flattened to show latter. *le*. labrum-epipharynx; *vp*. ventral plate of labium.

Fig. 29. Diagrammatic section through pharynx and proboscis of *N. amboinensis*. *da*. dorsal arm of pharynx; *dp*. dorsal plate of labium; *dph*. dorsal wall of pharynx; *hp*. hypopharynx; *le*. labrum-epipharynx; *lm*. lateral membrane; *oes*. oesophagus; *sr*. salivary ducts; *vp*. ventral plate of labrum; *vph*. ventral wall of pharynx.

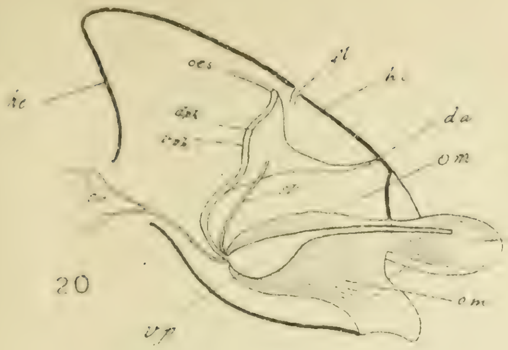
Fig. 28. Diagrammatic section through base of labium of *N. amboinensis*. *dp*. dorsal plate of labium; *hp*. hypopharynx; *le*. labrum. Epipharynx; *lm*. lateral membrane; *vp*. ventral plate of labium.

Fig. 29. Diagrammatic section through anterior part of labium of *N. amboinensis*. Lettering as in Fig. 28.

Fig. 30. Diagrammatic longitudinal section through pharynx and labium of a female of *A. speiserianum*. *h. c*. head-capsule; *om*. oral membrane. Other lettering as in Fig. 27.

Fig. 31. Diagrammatic section through base of labium of a female of *A. speiserianum*. Lettering as in Fig. 28.

Fig. 32. Diagrammatic section through anterior part of labium of female *A. speiserianum*. Lettering as in Fig. 29.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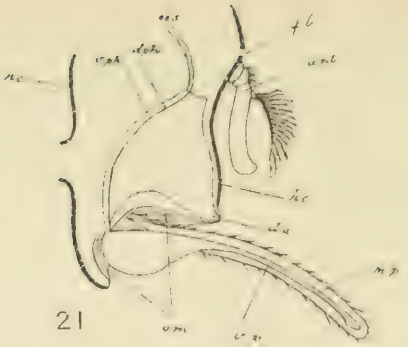
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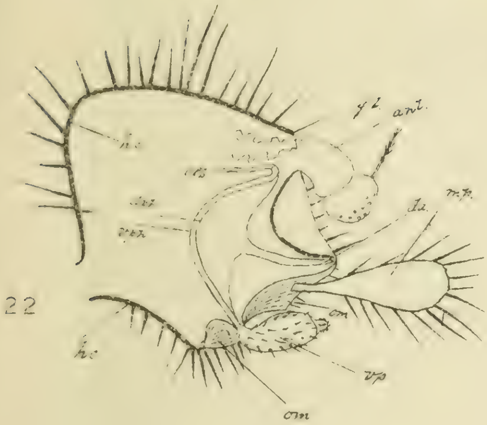
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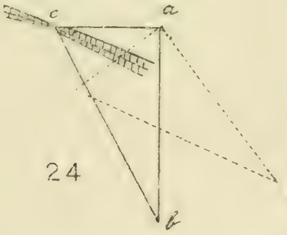

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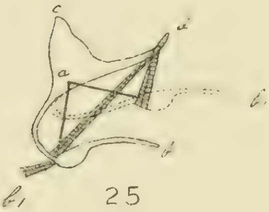

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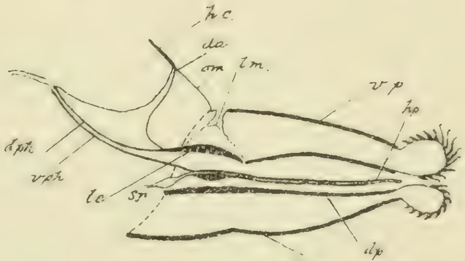
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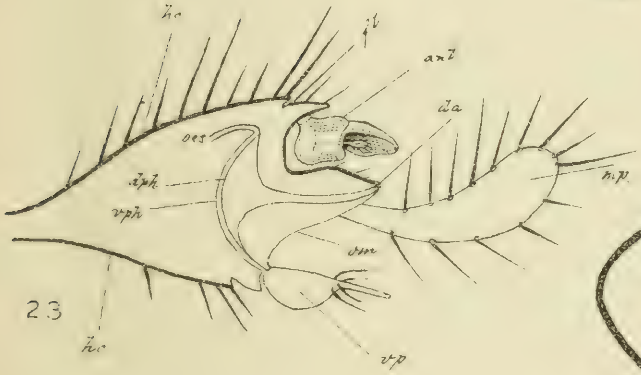
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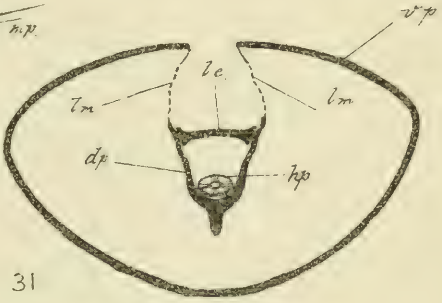
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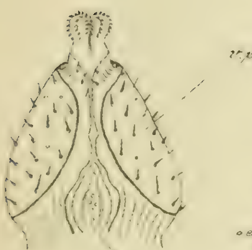

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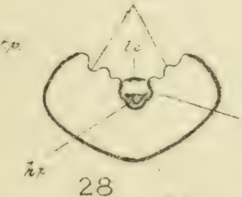
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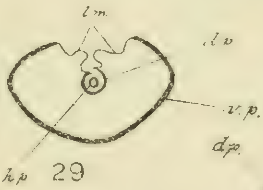

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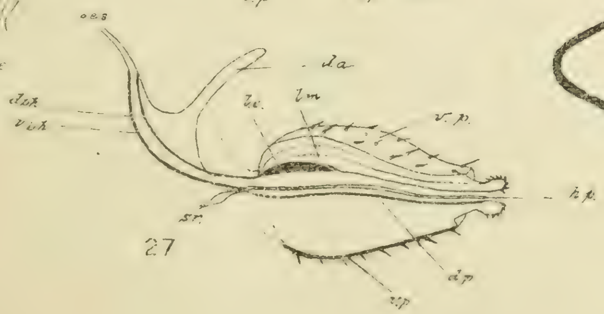
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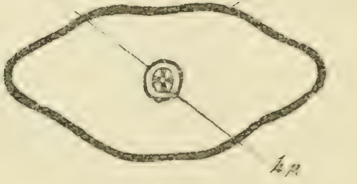

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Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
Vol. LIV. No. 12.

REPORTS ON THE SCIENTIFIC RESULTS OF THE EXPEDITION TO THE EASTERN TROPICAL PACIFIC, IN CHARGE OF ALEXANDER AGASSIZ, BY THE U. S. FISH COMMISSION STEAMER "ALBATROSS," FROM OCTOBER, 1904, TO MARCH, 1905, LIEUT. COMMANDER L. M. GARRETT, U. S. N., COMMANDING.

XXVI.

THE CTENOPHORES.

By Henry B. Bigelow.

With Two Plates.

[Published by Permission of George M. Bowers, U. S. Fish Commissioner.]

CAMBRIDGE, MASS., U. S. A.:
PRINTED FOR THE MUSEUM.
April, 1912.

No. 12.— *Reports on the scientific results of the Expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, by the U. S. Fish Commission Steamer "Albatross," from October, 1904, to March, 1905,* LIEUT. COMMANDER L. M. GARRETT, U. S. N., *Commanding.*

XXVI.

The Ctenophores.

By HENRY B. BIGELOW.

THE "Albatross," during her cruise in the Eastern Tropical Pacific, 1904–1905, collected only six species of Ctenophores, none of which are new. But the series is of greater interest than the paucity of its members would suggest, because up to the present time we have had almost no data of the fauna of the region and because the genus Hormiphora is represented by a series so large that it throws new light on the interrelationships of the various described species. The opportunity to study the material fresh from the net, which I owe to Mr. Agassiz, has been of great assistance.

CYDIPPIDA.

PLEUROBRACHIIDAE CHUN.

PLEUROBRACHIA Flemming.

Two Atlantic species of this genus are generally recognized, *pileus* known from both sides of the north Atlantic, and the Mediterranean *rhodopsis,* while Moser (**:09**) has recently described a third, *crinita,* from Greenland. Mayer (**:12**) describes a fourth, *P. brunnea,* but this is probably identical with *Hormiphora spatulata* Chun (p. 377). From the Indo-Pacific two species, *globosa* Moser and *pigmentata* Moser, are listed by Moser (**:09**) who has most recently surveyed the genus. *Pleurobrachia pileus, P. rhodopsis,* and the Pacific form described by A. Agassiz (**'65**) as *P. bachei* are very closely allied to one another. Moser (**:09**) considers *bachei* a synonym of *pileus.* The exact relationships of these forms have not been clear, partly because the Mediterranean form is known only from Chun's account of its young, partly because *bachei* has only very recently been figured (Torrey, **:04**, pl. 1, fig. 1).

Fortunately the Museum of Comparative Zoölogy contains a large series of adult and young *P. pileus,* several specimens of *rhodopsis* showing two stages in development, and 134 of *bachei* (one of them belonging to Agassiz's original material). The "Albatross" specimens, from the west coast of Mexico, are without question the latter, and from the standpoint of geographic distribution the opportunity to compare this form with the two Atlantic ones has proved instructive.

I. *Pleurobrachia pileus* and *P. rhodopsis.* According to Chun (**:80**) and to Moser (**:03**) the chief distinctions between these two are that in the latter the ribs are very short, and that the junction of the adradial canals with the meridionals is at the same level as the funnel. But the material which I have examined shows that neither of these distinctions holds good. One can hardly compare Chun's young (5–7 mm.) *rhodopsis* (**'80**, taf. 2, figs. 5, 6) with A. Agassiz's drawing of *pileus* at about the same stage (**'65**, p. 32, fig. 47) without being struck by the resemblance between the two, and by the fact that the ribs in the former are of about the same length as in the latter; but in neither is the exact level of the junction of canals shown clearly. Our smallest Mediterranean specimen is rather further advanced; the ribs are proportionately longer, now reaching from near the apex to about the mid level of the stomach; and the tentacular sheaths and bases are larger. The specimen differs from Chun's figure in having the opening of the sheaths nearer the aboral pole, while the adradial canals open into the meridionals slightly aboral to the funnel, instead of on a level with it.

Unfortunately I have no corresponding stage of *pileus* for comparison, but this difficulty does not hold for our largest and most interesting *rhodopsis.* This specimen though obviously somewhat shrunken is 9 mm. long. Probably it was at least 10 mm. in life. The ribs are much longer than in the younger specimen; they now reach from close to the aboral pole over $\frac{2}{3}$ of the length of the stomach; the tentacle-bases and -sheaths have increased in size, and the latter nearly equal the oral ends of the ribs; and the junction of adradial and meridional canals is appreciably above the level of the funnel. I was able to compare this example with *pileus,* at a corresponding stage, and of about the same size (9 mm.), and the only differences I could find between them were that the funnel-canal was slightly longer in *pileus,* the ribs slightly shorter. But in other specimens of *pileus* only slightly larger the funnel-canal is shorter, and the ribs longer;

in other words these differences are no greater than may be found in large series of *pileus*, which, as Moser has pointed out, shows great individual variability. In fact, it would be impossible to pick out this Mediterranean specimen from a series of *pileus* similarly preserved and of about the same size.

We must remember that with preservation Ctenophores almost always suffer more or less alteration of form and proportion, even though they may be in good condition anatomically, and for this reason slight differences in form and proportion between preserved specimens are to be looked on with suspicion. This specimen, which is the oldest Pleurobrachia yet described for the Mediterranean would require but little additional development for it to attain the stage so beautifully figured by L. Agassiz for *pileus*. All that would be necessary is progressive growth of the aboral half of the body resulting in proportionately longer stomach, ribs, and tentacular sheaths, and bases. This is exactly the line of development in *pileus*; and I have been able to follow it through successive steps to a specimen 24 mm. long. The most interesting feature of growth is the increasing size of the tentacular sheaths.

The progress of the change is already to be seen in the small Mediterranean specimens, and in larger *pileus* of 15–20 mm. The sheaths keep pace with the ribs, finally reaching nearly to the oral pole of the body. Moser (**:09**) has pointed out that the body, at first nearly globular, becomes more and more cylindrical as it increases in size, and that the stomach becomes proportionately longer, and that the tentacle-bases grow proportionately larger, and lie nearer and nearer the stomach. And my own studies entirely substantiate her account. In the adult condition the tentacular bases and the gastric cavity are variously affected by different preservatives. In life, so far as I have seen, the sheaths are always at an appreciable distance from the oesophageal canals and gastric wall; and the relative positions of the organs are retained fairly well in osmic-acid material. But in all the available specimens preserved in formalin the gastric cavity is so much dilated that its normal flattening is entirely obscured, and it is in close contact with the tentacle-sheaths. This warns us how cautiously we must employ such characters in preserved Ctenophores, especially in describing new species. The facts outlined above show that there is no sound distinction between *rhodopsis* and *pileus*. Instead of being a local species peculiar to the Mediterranean as Moser supposed, the former is merely an intermediate stage in the development of the latter, and therefore there is no longer any reason to query the record of "*rhododactyla*" (= *pileus*) from the Black Sea by Sovinsky (:**04**). Mayer (:**12**, p. 13) suggests that some of the Mediterranean records, and the record from Bermuda, may be based on young larval Bolinopsis. But such a mistake could hardly be made by anyone familiar with Ctenophores, for the tentacular sheaths of Pleurobrachia separate it at a glance from young of any of the Lobata. Larval Pleurobrachias so young that the tentacles still lie on the surface of the body might, of course, be confused with other larvae: but such criticism does not apply to the Mediterranean specimens noted above, nor to Chun's specimens.

We do not yet know whether the Mediterranean Pleurobrachias ever reach the large size attained by their Atlantic relatives. It may be that they represent a diminutive local race. Such races are not unknown among pelagic coelenterates; witness the progressive decrease in size in Cyanea as we follow it from north to south along the American coast. But such a difference alone does not warrant specific separation, and therefore I have no hesitation in relegating *rhodopsis* to the synonymy of *pileus*, of which it is at most a variety.

II. *Pleurobrachia pileus* and *bachei.* Torrey believes that these two are distinct. But Moser (:**09**) in her most recent discussion of the subject, unequivocally unites them, on the grounds that the slight difference mentioned by Torrey as distinctive of *bachei, i. e.* long funnel-canal, small tentacular sheaths, and junction of adradial and meridional canals aboral to the level of the funnel, are to be explained as due to different states of contraction. The only detail which she found difficult of explanation was Agassiz's statement that the tentacular sheaths of *bachei* open oral to the level at which the adradial canals open into the meridionals, instead of aboral to it, as in Torrey's specimens and in *pileus.* But this difficulty is not a real one because in one of Agassiz's original specimens, which I have been able to study and which is still in good condition, the openings of the sheaths bear precisely the same relation to the meridional canals that they do in *pileus.* Perhaps the original account was drawn from a violently contracted, or otherwise distorted example.

Inasmuch as Moser uses geographic distribution as a further reason for uniting the two species, I may point out that there is some confusion in the localities mentioned by her. The "Gulf of Georgia," given by A. Agassiz as the type locality for *bachei* is not, as she supposed, the coast of the state of Georgia, on the east coast of America and in about the same latitude as Bermuda, but is on the west coast, between Vancouver Island and the mainland, lat. 49° N., long. 124° W.

This fact, of course, removes the weight from the argument that it would be surprising if the *P. pileus* of Bermuda were replaced by another species at the type locality of *bachei*. Furthermore "Washington Territory" (Moser, **:09**, p. 145) is on the west, not on the east coast of North America.

Moser's discussion of *bachei* was drawn perforce from the published accounts, which certainly do not contain anything to show that it is not *pileus,* or at most a local Pacific variety of the latter. I was therefore particularly glad to have the opportunity of testing the validity on a series consisting of one of A. Agassiz's specimens from the Gulf of Georgia of moderate size, three from Puget Sound, one hundred and thirty-one specimens, taken by the "Albatross" off the coast of southern California, and many young specimens in the present collection from Acapulco, west coast of Mexico. All of these agree with *pileus* of corresponding ages except for the minor features that all have an unusually long funnel-canal, very short tentacular sheaths and bases, and by the fact that the adradial canals open into the meridionals well above the funnel level, that is to say, the characteristics are precisely those noticed by Torrey (**:04**) in his San Diego specimens. All these characters are shown by the youngest specimens, 3–4 mm. high. If we compare them with *pileus* at a corresponding stage, whether the Altantic (Agassiz, **'65**) or the Mediterranean race (Chun, **'80**) the difference is a striking one. In the Pacific example the funnel-canal is proportionately nearly twice as long as in one from the Atlantic or Mediterranean; and the opening of the tentacular sheaths and the junction of adradial and meridional canals much nearer the aboral pole. The differences do not disappear with growth; but are evident in specimens 10–12 mm. high. By this time the tentacular sheaths and bases have increased in size, growing toward the oral pole; but they lag far behind *pileus* (*cf.* Torrey, **:04**, pl. 1, fig. 1, with L. Agassiz, **'49**, pl. 3, figs. 1, 2). The funnel-canal is still longer than the digestive tract; whereas in *pileus* it is usually considerably shorter at all stages.

Our Puget Sound specimens are slightly larger, our Californian ones slightly smaller, than the San Diego material studied by Torrey; but they agree very well with his figure, except for the length of the ribs which depends on size, as might be expected. But in all, irrespective of contraction (and several are much shrivelled), the funnel-canal is longer than the gastric cavity, and the junction of adradial canals and meridionals lies at a level about half way between funnel and apex. Now, in all the Atlantic and Mediterranean specimens that

I have seen, the funnel is at least no longer than the oesophagus, and the canal junction lies on a level with, or slightly above the funnel. Apart from these features comparison, side by side, of considerable series has failed to reveal a single difference between the Atlantic and Pacific forms.

Moser (:**09**) has pointed out that *pileus* is extremely variable in form and proportions, both individually and with different stages in growth, a conclusion which my own observations substantiate; and the "*bachei*" type may well lie within the normal limits of variation of *pileus,* as Moser supposes, though I can not prove this as a first hand observation. Nevertheless the fact remains that all the Pleurobrachias of the *pileus* type yet recorded from the west coast of North America belong to a variety which is certainly not the prevailing one in the north Atlantic, although it may occur there. But the "*bachei*" form is apparently not generally distributed over the Pacific as a whole, for it is known only from the west coast between lat. about 49° N. and about 17° N.; and the Pleurobrachia record from New Zealand, is typical *pileus,* as are the records from the Seychelles, from South Africa, and from the Antarctic (Moser, :**09**).

Moser thinks it probable that the Pleurobrachias of the west coast of North America are carried thence by the cold "Polarstrom," and the "globular Ctenophore" mentioned by Chamberlain (:**06**) as common off the Alaskan coast is probably a Pleurobrachia, as is the "*Beroe octoptera*" of Mertens ('**33**) from Behring Straits. But to show how scanty our knowledge in this field is, I would point out that there is not another record of the genus from either side of the Pacific north of Puget Sound. Furthermore, I find no Pleurobrachias in all the extensive collections which have been gathered by the "Albatross" in the northwestern Pacific, though her voyages in that region have extended along the entire coast of Alaska, Behring Sea, the Aleutian Islands, and Japan, and, from year to year, have been prosecuted in every month from May to October.

In the meantime, however, some disposition must be made of the Californian Pleurobrachia in our system of classification. Decidedly it is not a distinct species. But on the other hand to unite *bachei* unreservedly with *pileus,* of which it is undoubtedly a component, will only hide the need of further investigation. Among the higher vertebrates the solution would be a subspecies, but inasmuch as this rank is not recognized among Ctenophores, Medusae, or Siphonophores, the most satisfactory way is to consider the form, for the time being, a variety.

Four more Pleurobrachias must still be considered:— *globosa* Moser, *pigmentata* Moser, *striata* Moser, and *crinita* Moser. The original specimens of *globosa* were all very small (1–6 mm. high), and immature. Slightly larger examples, up to 8 mm., have been described by Browne (:**05**) as *globosa* var. *ceylonensis*. The only important difference between them and Moser's material was that the ribs were somewhat longer; but this difference was evidently a concomitant of growth; in fact just what is to be seen in *pileus*. Moser mentions as its distinctive features:— very short ribs, long funnel-tube, opening of the sheaths on a level with the aboral ends of the ribs, and the fact that the adradial canals open into the meridionals in the oral $\frac{1}{3}$ of the latter, *i. e.* slightly above the level of the funnel. All but the last of these characters are shared with the young *bachei* in the present collection. But in the latter the adradial canals join the meridionals above the middle of the latter, just as they do in *pileus*.

It is unfortunate that we do not know what changes, if any, *globosa* undergoes with advancing growth; at present it is impossible to determine its status definitely. But the difference between it and all the other Pleurobrachias yet described is so striking that it must be recognized as a distinct species, at least provisionally. It is to be hoped that its adult will soon be discovered.

Pleurobrachia pigmentata and *P. striata* are very easily distinguished from all other Pleurobrachias by the pigmentation of the paddle-plates. In general appearance they suggest Tinerfe, but, unlike that genus, all the meridional canals develop sexual products. The differences between *pigmentata* and *striata* are that the latter is more nearly cylindrical than the former and has a larger mouth, the fact that its ribs are unequally spaced, slightly shorter and narrower, and that the cilia are larger. But these are just the characters which are most readily altered by preservation; I have seen the differences in form, in the mouth, and in the cilia outlined above appear after preservation in a series of *pileus* which I had previously examined and found indistinguishable in life, and that, too, when all were put into the same bottle of formalin. The spacing of the ribs may be of more importance but in shrivelled *pileus* the spacing often becomes unequal. I therefore doubt whether *striata* is distinguishable from *pigmentata*. *P. crinita* is separated from its relatives by "die konische Gestalt, die grosse Länge dei Rippen und Schwimmplättchen und durch die Form des Mundes, der in vier Zipfeln von hornartig gekrümmter Gestalt ausgezögen ist" (Moser, :**09**, p. 148). These features are not paralleled in the large series of the only other Arctic Pleurobrachia, *P. pileus,* which have been examined by Moser, and by the writer.

Finally, *Euplokamis australis* Benham (: **07**) is apparently a Pleurobrachia, to judge from its tentacular sheaths. In form it resembles the more cylindrical specimens of *pileus,* though it differs from specimens of that species of corresponding size in having much shorter tentacular sheaths, and longer ribs. But the fact that *pileus* is now known from New Zealand suggests that *australis* is an extreme variant of that unstable form.

PLEUROBRACHIA PILEUS Fabricius. var. BACHEI A. Agassiz.

Pleurobrachia bachei A. Agassiz, in L. Agassiz, '**60**, p. 294; '**65**, p. 34; Moser, : **03**, p. 6; Torrey, : **04**, p. 46.

Acapulco Harbor, surface, about one hundred and fifty specimens from 2–4 mm. high. Also, off the coast of California, lat. 37° N., long. 122° 20′ W., 131 specimens, 7–12 mm. high. Puget Sound, three specimens, 10 mm. high. Gulf of Georgia, one specimen, collected by A. Agassiz, 1865. This example is now so much flattened that its dimensions can not be determined. But it is large.

The more important features of the series have been described above.

HORMIPHORA L. Agassiz.

Hormiphora is closely allied to Pleurobrachia, from which it is separable only by the fact that the tentacular bases and sheaths lie close to the paragastric vessels, instead of mid-way between them and the outer surface of the body. And I agree with Mayer (: **12**) that it will probably be united with Pleurobrachia in the future. But it may be retained temporarily until its members are better known.

The collection contains so large a series of one species of this genus (upwards of two hundred and sixty specimens) that it affords an opportunity to test the constancy of some of the characters on which the various Hormiphoras are based. The latest account of the genus is by Moser (: **09**) who recognizes no less than nine species, *H. hormiphora* Gegenbaur ('**56**),[1] *spatulata* Chun, *palmata* Chun, and

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[1] This species has universally been called *H. plumosa,* under which name L. Agassiz ('**60**) made it the type species of the genus. But the specific name *plumosa* was not proposed by Sars until 1857, while Gegenbaur had described it as *Cydippe hormiphora* the year before. Under the International rules of zoölogical nomenclature the older name must be used.

punctata Moser from the Atlantic, *ochracea* Agassiz and Mayer, *fusiformis* Agassiz and Mayer, *sibogae* Moser, *amboinae* Moser, and *japonica* Moser from the Indo-Pacific. The Californian "*Mertensia ovum*" of Torrey is also evidently a Hormiphora. My own studies on a very large series have convinced me that not all of these are good species, and the necessity of identifying our own material requires a preliminary revision of the genus as a whole.

To begin with, *ochracea* can at once be accorded a definite status, if the character by which it is distinguished, entire absence of tentilla except at a very young stage (Moser, **:03**), be normal. And inasmuch as two collections, made several years apart and at localities as far separated as off the west coast of America and the Malayan waters agree in this respect, and furthermore, when Moser, who alone has described adults of *ochracea* has also studied other members of this genus, we can hardly credit the absence of tentilla to mutilation. I have never seen a specimen of it myself. Apart from tentacular structure, *ochracea* may possibly be distinguished by very long meridional canals contrasted with short ribs; but as we shall see, this character is a variable one.

H. spatulata, according to Chun's (**'98**) account and figures, is readily distinguished from all other Hormiphoras by the fact that the tentacular sheaths diverge widely from the stomach at their oral ends, and that it is only the upper (aboral) ends of the bases of the tentacles which lie close against the gastric wall. And this account has recently been corroborated by Moser (**:09**) for a well preserved specimen from the west coast of Spain. A Ctenophore with this same characteristic, and resembling *spatulata* likewise in general form, has been described from the East coast of North America by Mayer (**:12**) as *Pleurobrachia brunnea.* According to him it is distinguished from *spatulata* mainly by the presence of terminal knobs on the tentacles; but as Chun's figure of *spatulata* (**'88**, taf. 3, fig. 3) shows a terminal knob-like tentillum on one of the tentacles, it appears that the supposed difference in this respect is not valid. *P. brunnea* is almost certainly a synonym of *spatulata.* In all the numerous Hormiphoras of the "Albatross" collection (p. 38) the tentacular sheaths are in close contact with the oesophagus throughout their length, so there is a discontinuity in this respect, sufficient to distinguish them from *spatulata.* Larvae of *spatulata* have two kinds of tentilla, ordinary filiform, and large spatulate. But in the adult the latter are lost (Chun, **'98**, taf. 3, fig. 4).

The species which remain are less easily disposed of. The form described by Chun ('**98**) as *palmata* is especially confusing because the name was based on the combination of a very early and of a mature stage the connection of which with each other was only a supposition. His young "*palmata*" is characterized by having peculiar eolid tentilla as well as filiform ones, and in this it agrees with the type species of the genus, *H. hormiphora.* It further agrees with *hormiphora* in general form, and in the fact that the adradial canals meet the meridionals at about the level of the funnel. The only distinction between this larva, and the adult *H. hormiphora,* except for differences in development which might be expected, is that the eolid tentilla are proportionately larger, more numerous, and with fewer processes, in the former than in the latter.

Now, although *H. hormiphora* is common in the Mediterranean (Gegenbaur, '**56**, Sars, '**57**, Chun, '**80**), and the adult has been well described and figured (as "*plumosa*") by Chun, and by Mayer (**:12**) our only information about its young stages is his figure of a very young larva, so young, in fact (2 mm. long) that filiform tentilla alone have yet appeared; from the stoutness of its ribs, too, it is obviously much younger than his young "*palmata.*" Chun himself has observed that the very youngest "*palmata,*" 3 mm. long, have no eolid tentilla, and that the first tentilla to appear are the filiform ones.

We need assume merely that the eolid tentilla of the young "*palmata*" become more complex individually, without a corresponding increase either in size or in number beyond the stage which Chun figured, to attain the conditions seen in the adult *H. hormiphora.* There is certainly no evidence that the eolid tentilla would not undergo further individual development. Indeed the figure (Chun, '**88**, taf. 3, fig. 1) shows that the oldest (terminal) ones have more lateral papillae than the younger ones. And judging from conditions in a group of coelenterates, *i. e.* the Siphonophores, in which complex tentilla are the rule, not the exception, progressive development of the lateral processes is just what we might expect.

The developmental series from larval *H. hormiphora,* through Chun's young "*palmata*" stages in which the eolid tentilla appear, and become more numerous and complex, to the adult *hormiphora* reached by progressive development of the individual tentilla as well as of the animal as a whole, is thoroughly in accord with the facts as we know them; there is nothing to forbid the connections here outlined. On the other hand the association of the young "*palmata*" with the full-grown Hormiphora which Chun ('**98**) believed to be its adult is supported by no actual evidence. The five large examples had no eolid tentilla, and the tentacle-bases and -sheaths agree no better with the young *palmata* than do those of the adult *hormiphora.* Chun himself says ('**98**, p. 18) "Die Beobachtung des lebenden Thieres wird erst einen sicheren Entschied liefern, ob dieser .... Cydippiden den oben geschilderten Jungendformen zugehören." The young "*palmata*" was taken in the Straits of Gibraltar.

But even though I believe Chun's young "*palmata*" is a stage in the development of *H. hormiphora,* the name *palmata* is not to be abandoned, but must be applied to the adult Hormiphora described by Chun under that name, which proves to be an important and widely distributed species.

If we turn now to the Indo-Pacific Hormiphoras, of which *ochracea* has already been treated, we find that two of them, *amboinae* and *japonica,* closely resemble Chun's adult *palmata,* and the same is true of the large Eastern Pacific series. All of them are ovoid in general form, flattened but slightly, if at all, in the pharyngeal plane and they are proportionally much longer than *H. hormiphora.* In all of them the adradial canals join the meridionals at about the level of the funnel, or very slightly above it; the tentacle-sheaths are closely apposed to the gastric tract throughout their length and reach about to the end of the meridional canals, and open above the level of the funnel; and all have filiform tentilla.

The characters separating *palmata, amboinae,* and *japonica* from one another are the precise height at which the tentacular sheaths open to the exterior, the exact outlines of the sheaths and of the bases of the tentacles, the form of the apex, whether truncate or not, and the proportional length of meridional canals and ribs. But the very large series collected by the "Albatross," which I examined both in life and after preservation, show that all these characters are variable, both normally and with contraction, and that the conditions illustrated by the three forms are well within the limits of variability of a single species.

In *amboinae* the sheaths open close to the apex, which is truncate; in *palmata* they are only about one third the distance from funnel to apex, *japonica* is intermediate between the two, and our specimens afford further connecting links; while the truncation of the apex in *amboinae* is a contraction-phase, paralleled by many of our examples. The outlines of the sheaths are equally variable, being more or less voluminous, and so is the form of the tentacular base, which is variously curved, or straight. These features are much affected by preservation — furthermore, as shown in the figures (Plate **1**, fig. 5, 6), the proportionate length of ribs and meridional canals is individually variable, even in the different canals of a given individual, while different individuals from one haul show the extremes illustrated by *palmata* and *japonica* as well as intermediates connecting them. Judging from these facts, no course is open but to refer *amboinae*, *japonica*, and the "Albatross" specimens to *palmata*. That this species should occur both in the Atlantic and in the Indo-Pacific is not at all surprising, indeed, the case exactly parallels that of many oceanic Medusae and Siphonophorae.

H. fusiformis Agassiz and Mayer, agrees with *palmata* in its general form, in its tentilla, and in the outlines of its tentacular sheaths, but differs, according to their account, in the fact that the adradial canals join the meridionals above the level of the funnel. Furthermore, their figure (:**02**, pl. 13, fig. 59) shows the tentacle arising from one end of the base, instead of from the middle, something which, as Moser has pointed out, does not occur in any pleurobrachiid. Fortunately I have been able to study a large series from the Hawaiian Islands, including two specimens labelled by Mayer himself, and though all of them are more or less fragmentary, they are in good enough condition to show that the canal-junction is at the level of the funnel, just as in the eastern Pacific series, and that the structure of the bases of the tentacles is of the usual type. In short, there is nothing to separate them from *palmata*. Therefore *fusiformis* can safely be relegated to the synonymy of *palmata*. It is still a question whether *palmata* is really distinct from *hormiphora*, or whether the two are varieties of a single species; and until the matter is settled, it is better to retain both names.

One other Ctenophore closely resembles *H. palmata*, the "*Mertensia ovum*" of Torrey (:**04**, pl. 1, fig. 1), which, as Moser has pointed out, has nothing to do with the genus Mertensia. Its status is somewhat confusing because Torrey does not refer to the figure in his text, nor does he list *Mertensia ovum* as having been taken at San Diego, where, indeed, its presence would be most unlikely. Judging from the account of his *Euplocamis californensis* (Torrey, :**04**), I have no doubt that the figure in question belongs to that form, and that the legend on the plate is erroneous. So far as the figure shows, the species is probably not separable from *H. palmata* with which it agrees in general. The only points of difference are that the meridional canals reach almost (but not quite) to the mouth, and that the tentacular sheaths are shorter than is usually the case in *palmata*. But I have seen one specimen of the latter (Plate **1**, fig. 2) almost exactly paralleling

Torrey's figure in the latter respect, though with shorter meridional canals. Without examining specimens I hesitate to assign a definite status to this form, though I am of the opinion that it will eventually prove to be *palmata*.

Hormiphora punctata Moser, is remarkable among Hormiphoras from the fact that the ribs are pigmented; a character in which it parallels *Pleurobrachia pigmentata* Moser. Unfortunately the single specimen (4 mm. long) was in very poor condition, and, to judge from the figure, much contracted. Better material will be required to show whether it is really generically distinct from Chun's *Tinerfe coerulea* which it much resembles in general appearance.

H. sibogae Moser is a species so easily distinguished from all other Hormiphoras by its very short meridional canals, small and short tentacle-sheaths, retracted apex, and junction of meridional and adradial canals well above the level of the funnel that there is no doubt of its validity. The only tentillum observed was of a peculiar trefoil-like outline.

Finally, we have the case of the *Beroe cucumis* of Mertens (**'33**). Moser (**:09**) has referred this species to "Cydippe," hesitating to locate it in either Pleurobrachia or Hormiphora, to one or other of which she believes that it belongs. Mertens's excellent figures show that it is undoubtedly a Hormiphora; but its exact relationships to the other members of that genus can be settled only by an examination of new material.

HORMIPHORA PALMATA Chun.

Plate **1**, figs. 1–6.

Hormiphora palmata Chun, **'98**, p. 17, pl. 3, fig. 2 (*non* pl. 3, fig. **1**) (*partim*).

Lampetia fusiformis Agassiz and Mayer, **:02**, p. 171, pl. 13, figs. 59, 60.

Hormiphora fusiformis Mayer, **:06**, p. 1134.

Hormiphora amboinae Moser, **:08b**, p. 8, pl. 1, fig. 4.

Hormiphora japonica Moser, **:07**, p. 450, **:08a**, p. 10, taf. 1, figs. 6–8.

? *Euplokamis californensis* Torrey, **:04**, p. 46.

? *Mertensia ovum* Torrey, **:04**, pl. 1, fig. 1.

Station 4600, about 200 specimens, 15–27 mm. long. A swarm was encountered at this Station on the surface.

Station 4627, 2 specimens, both about 17 mm. long.
" 4631, 2 " 25 and 15 mm. long.

Station 4638, 1 specimens, fragmentary.
" 4642, 1 " " 16 mm. long.
" 4650, 2 " both 16 mm. long.
" 4652, 3 " 16 mm. long.
" 4656,
" 4682, 1 " 35 mm. long.
" 4689, 2 " both 22 mm. long.
" 4691, 1 " fragmentary.
" 4713, 1 " "
" 4718, 1 " 32 mm. long.
" 4729, 1 " 24 mm. long.
" 4731, 2 " 25 and 15 mm. long.
" 4735, 1 " fragmentary.
" 4741, 1 " 22 mm. long.

Also Hawaiian Islands, 19 specimens, all somewhat injured.

Southeast coast of Japan, 35 specimens, 10–35 mm. long, collected by the "Albatross."

Except as noted above, the material is in excellent condition, but unfortunately there are no very young stages. The specimens are all considerably longer than broad, more or less narrowed at each pole, and but slightly flattened in the pharyngeal plane. But, as shown in the accompanying table, the precise proportion between length and diameter varies considerably; and the same is true of the polar narrowing.

Table of dimensions and proportions: in the latter length is taken as the unit.

Dimensions			Proportions		
Length	Greatest diameter	Least diameter	Length	Greatest diameter	Least diameter
mm.					
8	5	4.5	1	.55	.50
9	6	5.5	1	.66	.60
9	6	6	1	.66	.66
12	8	6	1	.66	.50
13	13	12	1	1	.92
15	7	6.5	1	.46	.42
18	10	9	1	.55	.50
22	8	6	1	.36	.27
22	11	9	1	.50	.41
24	13	11	1	.54	.45
25	10	8	1	.40	.32
35	13	10	1	.37	.28

The best preserved specimens agree in general with the photograph (Plate **1**, fig. 1); but one very large example is more spindle-shaped, approaching Agassiz and Mayer's (:**02**) figure of their *fusiformis.* The series from Station 4600 are all soft and flaccid, and in most of them the aboral pole is more or less retracted. But these specimens were collected before I joined the ship, and experiments showed that the difference in solidity and outline between them and the specimens collected later were due to differences in preservation. Differences in preservation, especially whether or not the specimens were stupified in chloretone, cause differences in the degree of protusion of the mouth, and in general form and proportions (*cf.* fig. 1, fig. 2).

Tentacles and *sheaths.* The tentacular sheaths are voluminous, and in the better specimens their form (Plate **1**, fig. 1) agrees very well with Chun's ('**98**) figure, and with Moser's figure (:**08b**) of *amboinae.* But they vary in their precise outlines; in some of the specimens they are narrower (Plate **6**, fig. 2), just as Moser (:**08a**) has figured them for *japonica,* and there is a series of intermediates connecting the two extremes. The differences are nothing more than contraction-phases. The precise level at which the sheaths open to the exterior is likewise a variable feature, so much so as to be worthless as a specific character unless used within broader limits than the range included in the synonyms of *palmata.* In the best preserved examples the opening is at a level varying from $\frac{2}{5}$ to $\frac{1}{2}$ the distance from funnel to apex (Plate **1**, fig. 1). In *japonica* it is at about $\frac{2}{5}$; in Chun's specimen it was slightly nearer the level of the funnel.

In the flaccid specimens from Station 4600 the sheaths open higher, just as they are figured for *amboinae* (Moser, :**08b**, pl. 1, fig. 4); but the difference is largely due to the fact that in them, as in *amboinae,* the apex is more or less retracted by preservation. In two small specimens the level of the tentacular opening is about $\frac{2}{3}$ the distance from funnel to apex. The series shows that the differences in this respect noted by Moser are not specific.

In most of the specimens the basal ends of the sheaths fall a little short of the oral ends of the meridional canals (Plate **1**, fig. 3, 6). In some, the canals extend even further beyond the sheaths, but on the other hand the sheaths in other examples are longer than the canals (Plate **1**, fig. 5) as in Moser's figure of *japonica,* and in still others sheaths and canals reach about the same level, as in *amboinae* and in Chun's specimens.

The size and form of the bases of the tentacles have been used by Moser as specific characters — but both of them vary beyond the narrow limits drawn for them by that author. In most of the specimens they reach aborally to about the level of the funnel (Plate **1**, fig. 1), as in Chun's specimen. But in some they are much shorter, the precise length varying with contraction. On the other hand the tentacle-bases in flaccid specimens may surpass the funnel aborally, and extend orally almost to the ends of their sheaths: *i. e.* in examples in which the body as a whole is shrivelled or contracted and the tentacle-bases expanded, we may have precisely the characters of *amboinae.* The bases of the tentacles are usually bowed outward, *i. e.* away from the gastric cavity, at their mid-points (Plate **1**, fig. 1), as figured by Moser (:**08a**) for *japonica.* But they vary from this condition to one in which they are practically straight (Plate **1**, fig. 2): in a rather flaccid specimen 12 mm. long, only one of the bases was bowed outward, and in two of the large Japanese specimens both bases (Plate **1**, fig. 6) showed the double curve figured by Chun ('**98**). These facts demonstrate that there is no ground for making the curve of these organs a distinguishing feature between *japonica* and *palmata.* The tentacles are contracted, but many of them still bear considerable numbers of tentilla, all of the filiform type though variously shrivelled by preservation (Plate **1**, fig. 2).

An important specific character in Hormiphora is afforded by the level at which the adradial canals join the meridionals. In all the present series the junction takes place at about the level of the funnel or very slightly above it (Plate **1**, figs. 1, 3), and the same is true of the specimens figured by Chun and by Moser.

Meridional canals and *paddle-ribs.* The ribs are as a rule rather shorter than the meridional canals; but the difference in length varies from practically *nil* (Plate **1**, fig. 5) through a continuous series of intermediates, to a very considerable one (Plate **1**, fig. 6); Chun's and Moser's figures all fall within the limits of variability of the present series; therefore the slight difference in this respect between *japonica* and *amboinae* on the one hand, and Chun's specimen of *palmata* on the other, is not specific but merely individual. It does not seem to be influenced to any great extent by contraction. The ribs, as noted by Moser (:**08a**) commence close to the apex, and end slightly below the oral end of the tentacular bases. As pointed out above, the ends of the meridional canals bear a similar relation to the ends of the tentacular sheaths. It is impossible to make any exact statement as to the proportional length of ribs to body as a whole, because the latter varies so much with the degree to which the mouth or pharynx is protruded or contracted. In several of the largest specimens all the paddle-plates were lost, without the animals being injured in any other way. But this was, of course, accidental, as shown by a specimen in which one of the ribs had lost them all, while the others were normal.

The funnel-canal is narrow, but in contracted specimens is abnormally broad, and often folded or twisted (Plate **1**, fig. 2); and this is obviously the explanation for its shortness and enlarged calibre in *amboinae* (Moser **:08b**, pl. 1, fig. 4).

Color. In life the tentacles and their bases were chrome-yellow; otherwise the animals were colorless.

BEROIDA.

BEROIDAE ESCHSCHOLTZ.

BEROE BROWNE.

Moser (**:08a**), in her account of the Japanese Ctenophores, recognizes five species of Beroe, enlarging the list admitted by Chun (**'80, '98**), *i. e. ovata, forskalii,* and *cucumis,* by the rehabilitation of *clarkii* L. Agassiz, and by a new recently discovered species, *hyalina* Moser; and she has since (**:09**) described a sixth, *compacta,* from the collection of the German Antarctic expedition. Only three of these, *ovata* and *forskalii* from Naples, and *cucumis* from various localities on the east coast of North America, including Labrador and Florida, have come under my observation; they are so easily distinguished by structural characters that they are not likely to be confused.

The Beroes fall into two main divisions, according as the pharyngeal canals are simple or branched; and, as Moser points out (**:08a**), this character is a very convenient one, because the condition of the canals can usually be determined even in fragmentary specimens. The first group, with simple canals, has two members, *cucumis* and *hyalina.* The latter is distinguished, according to Moser, by its short ribs, and by the fact that the sensory body is sunken, just as it is in the cydippids, and by the unusual transparency. But the small size of the recorded specimens of *hyalina,* 11–15 mm. naturally raises the question whether these characters would be found in the adult, for, as is well known, the ribs in all Beroes are at first very short, and *ovata* and *forskalii* have simple gastric canals in early stages. It is true that Moser found genital products, but in *forskalii* at any rate these appear long before mature size is attained. Such considerations, do not necessarily invalidate *hyalina* as a distinct species, but they certainly indicate the desirability of further study of it on more extensive material.

The second group, with branched gastric canals, includes *ovata, forskalii,* and *clarkii.* My own studies entirely support Chun and Moser in the view that the first two are easily separated both by general form, which is constantly different, by differences in the meridional and gastric canal-nets, and, most important, in the location of the gastric products, which are arranged in diverticula from the canals in *forskalii,* instead of in continuous bands, as in *ovata.* *B. clarkii* has recently been redescribed and figured by Moser. According to her (**:09**, p. 158), it is "kenntlich an der Form und an der charakterischen Verteilung der Rippen auf der Körperoberfläche"; that is to say, it is unusually broad, slightly constricted just above the wide mouth, and the subventral ribs are much closer together than the subtentacular, which are curved. The largest specimen was upwards of 16 mm. long, the smallest 2–3 mm. There is another recently described Beroe of the *ovata* type, *B. shakespeari* Benham (**:07**) from New Zealand, which agrees with Moser's account of *clarkii* in form, in the shortness of its ribs, and in the fact that near the aboral pole the subventral ribs lie close together. The only difference, besides size (the specimens of *shakespeari* were from 27–62 mm. high), was that in *shakespeari* the mouth was small, instead of large. But, as I have myself observed in *cucumis,* the mouth may or may not be contracted by preservation. In short, *clarkii* and *shakespeari* are undoubtedly identical, and probably represent, not a distinct species, but a variety of *ovata,* with which they agree so far as the arrangement of sex-products and branching of the canals is concerned and Mayer (**:12**) unequivocally unites them with *ovata.*

Beroe compacta is remarkable for the thickness of the gastric walls and for having very little gelatinous substance. It is so far known from one young specimen of 4 mm. only. Further details as to the canal system would be helpful. In general form it suggested a Pleurobrachia, but there was no trace of tentacular apparatus.

The genus Beroe is represented in the "Albatross" collection by only a few specimens, all small; and most of them in fragments when taken from the net. So far as I can determine all belong to *forskalii.* This is an appropriate place to record two larger *forskalii* from Fiji collected in 1897 by Mr. Agassiz. These probably were the basis for *B. australis* Agassiz and Mayer (**'99**). But the label merely gives the locality and date, so it is impossible to be certain. *Beroe australis* has already been referred by Moser to the synonymy of *forskalii*.

BEROE FORSKALII Milne Edwards.

Beroe forskalii Milne Edwards, **'41**, p. 207, pl. 5 (*partim*).
For further synonymy, see Chun (**'80**) and Moser (**:09**).

Station 4654, 300–0 fathoms, 1 specimen 8 mm. long.
“ 4719 300–0 “ 1 “ 29 mm. “
Fiji, Suva Harbor, Dec. 13, 1897, 2 specimens, 22 and 25 mm. long.
Fragments probably belonging to this species were taken at
Station 4638, 300–0 fathoms, 1 specimen.
“ 4651 “ “ 2 “
“ 4657 “ “ 2 “
“ 4665 “ “ 1 “
“ 4721 “ “ 1 “

It is noteworthy that not a single Beroe was taken in a surface haul.

The smallest specimen is at about the same stage as the 6 mm. larva figured by Moser (**:09**, pl. 2, fig. 5); the ribs now extend over the aboral $\frac{1}{3}$ of the body, and a few of the branches of the meridional canals anastomose. The gastric canals are still simple.

The specimen from Station 4719 is larger than the Fiji specimens, though younger, a discrepancy explained by different methods of preservation. The former in formalin is just the same size as it was in life, the latter, fixed with osmic acid and now in alcohol, are obviously contracted. The younger specimen already shows the flattening, somewhat pointed apex, and proportionately broad mouth characteristic of the adult *forskalii*, but the ribs, all of which are the same length, are only about half as long as the body. The meridional canals send out numerous blind branches, but only a few of them unite, so we can hardly speak of a network as yet. The gastric canals are simple through their aboral third, but oral to this they give rise to a few branches which connect with the meridional system through occasional transverse stolons. The specimens show an early stage in the formation of the sexual products, the margins of the meridional canals being slightly and irregularly lobed, even slightly beyond the extremities of the ribs. Thus, though development has progressed somewhat, the main change from the larva described above is in size and in the length of the ribs.

The Fiji specimens are much further advanced in growth. In general form they agree very closely with adult specimens from Naples. The ribs now extend over about two thirds of the body, and none of the meridional branches anastomose. But the meridional net is still far less complete than in the adult, and the gastric net is still represented by a few branches, and occasional stolons which connect the gastric and meridional systems. The most important advance is in the sexual diverticula from the meridional canals, which have now reached practically the adult condition. It is interesting to note that the sexual lobes extend to the ends of the canals, *i. e.*, nearly to the mouth, although the paddle-ribs cover only about two thirds of the length of the canals. This, as noted above, was foreshadowed in the younger specimen. Chun (**'80**, p. 309) says that the formation of sexual products ceases at the ends of the ribs; but this statement is true only in the adult, where the ribs extend over four fifths or more of the length of the canals.

Beroe forskalii has been recorded from Fiji, from the coast of California, and from various localities among the Malay Islands; and the present captures show that it is widely distributed, though apparently not very common, in the eastern part of the Tropical Pacific. It is also recorded by Maas (**:08**) from the Antarctic. Although his material was not in the best of condition, it showed clearly that the gastric canals were branched, a fact separating it definitely from *B. cucumis*, which is the representative of the genus which might have been expected in that region. The specimens likewise agreed with *forskalii* in form, but it is better not to lay too much stress on this character in preserved specimens. Unfortunately Maas could not determine the arrangement of the gonads, which is the most important feature separating *forskalii* from *ovata*. A fresh examination of the Beroes of the Antarctic would be valuable, because apart from this one record, *B. forskalii* is known only from warm and temperate regions.

PANDORA Eschscholtz.

The genus Pandora, merged with Beroe by Chun and by Mayer (**:12**), has been reinstated by Moser, to include those species which agree with Beroe in anatomy, but in which the ribs are of unequal length. This difference is, of course, a slight one. But the diversity in the length of canals, in forms in which it occurs, is present in the earliest stages in which any of them are known, while, on the other hand, all the ribs in Beroe are nearly or quite of one length from the beginning. Furthermore, each type of rib characterizes several species; and no form is yet known intermediate between the two For these reasons Pandora seems worthy of generic rank. The genus is especially interesting because it may afford a case of "dissogonie" in the cases of *P. pandorina* Moser and of *P. flemmingi* Eschscholtz. Moser (:**03**, p. 26) has given a thorough discussion of these two species, pointing out the possibility that they may belong to a single developmental series. Briefly stated, the difference between the two is that *pandorina* is small, with very large stiff cilia about the mouth, and sexually mature, while *flemmingi* is much larger (up to 25 mm. high) with small, slender lip-cilia, and not mature even at this large size. No intermediates have yet been found, and it is to be hoped that some student will shortly have access to more complete series of the two.

P. mitrata Moser (:**08a**) from Japan differs from *P. flemmingi* in being cylindrical when adult, and in the fact that the branches of the meridional canals run toward the mouth and anastomose much less often than they do in *flemmingi*. According to Moser its gastric cilia are unusually thick and long, as in *P. pandorina*. The "Albatross" collection contains a single specimen which agrees very closely with Moser's figure and descriptions of *mitrata*.

The *Beroe punctata* of Chamisso and Eysenhardt is also included in Pandora, by Moser (:**08a**) on the strength of Eschscholtz's statement that its ribs were of unequal lengths. No unquestioned record of it has since been obtained. Until it is redescribed it must remain on the doubtful list.

PANDORA MITRATA Moser.

Pandora mitrata Moser :**07**, p. 451, :**08a**, p. 34, taf. 1, fig. 1–3; :**09**, p. 159.

Station 4727, surface, one specimen, 16 mm. high, in good condition.

The single example agrees so well with Moser's figures that a detailed account is unnecessary. The ribs are slightly longer, the subventral extending over about two thirds, the subtentacular over slightly less than one half of the body; but the mouth-region is somewhat contracted, so it is positive that the discrepancy is to be explained at least partially by preservation. The branches of the meridional canals are mostly blind, and all run toward the mouth, exactly as Moser figures them, and the gastric canals are unbranched.

Corresponding to the flattening of the body, the subventral ribs of each pair lie close together, the subtentacular further apart. The sexual products occupy the meridional canals only so far as the ends of the ribs, and where they occur the margins of the canals are very slightly lobed. In Moser's specimens the cilia of the stomach agree with those of *P. pandorina, i. e.,* they are unusually stout and long, and there was no "Wimperschnur um den Mund." So far as I can judge from surface views with the microscope, the conditions are the same in the "Albatross" specimens. Certainly there is no visible band of cilia surrounding the mouth; and wherever a few gastric cilia can be distinguished they are remarkably stout. But for the most part they are gone.

To judge from the three records of this species, Japan (Moser), west coast of South Africa (Moser), and the Eastern Tropical Pacific, it is very constant in character. All the older specimens agree in having unequal ribs, and in their arrangement in pairs, in general form and proportions, in having a large mouth, in the type of branching of the meridional, and simplicity of the gastric canals; and in the limitation of the sexual products to the portions of the canals occupied by the ribs. The present capture is interesting from the standpoint of geographical distribution, as showing its wide dispersal over the Pacific, and that it occurs there on both sides of the Equator. In the Atlantic it is so far known only from lat. 32° 5′ S., long. 8° 30′ W.; between Ascension and St. Helena, and from near Cape Town (Moser, **:09**). But its general resemblance to a Beroe is so great that it might easily be overlooked by anyone but a specialist.

LOBATA.

BOLINOPSIDAE nom. nov.

BOLINOPSIS L. Agassiz.

While the "Albatross" lay at anchor in Acapulco Harbor I was able to study, in life, a large and beautiful Bolinopsis,[1] of which several specimens were taken. Moser has recently attempted a revision of this genus, and done much to bring order out of confusion, though the relationships of the several forms recorded from tropical regions are

[1] Bolina is preoccupied for a mollusc (Mayer, **:12**, p. 20).

still unsettled. Moser agrees with Vanhöffen ('95) that the north Atlantic *infundibulum* and *alata*, and the Behring Sea *septentrionalis* all belong to one species of circumpolar distribution. This view seems to me thoroughly in accord with the various published figures and descriptions, and my own studies of living specimens from the coasts of New England lead me to adopt it without hesitation. The best figures of the New England form are those by L. Agassiz ('49); of the north European by Vogt ('88). *B. infundibulum* is the only species which is known from more than very few records; and even for it the normal limits of variation are still to be traced. Under these circumstances it is very difficult, perhaps impossible, to reach a sound conclusion as to the relationships of the various other species.

The following are listed by Moser (:08a): — *hydatina* Chun from the Mediterranean, *elegans* Mertens from the "South Seas," *chuni* von Lendenfeld from south Australia, *vitrea* L. Agassiz ('60) from the southeastern coasts of the United States, *ovalis* Bigelow (:04) from the Maldive Islands and *mikado* Moser (:07, :08a) from Japan. And to show how little we know about them, I may point out that *ovalis* and *mikado* were each described from a single fragmentary specimen, *elegans* from a single record in 1827, and *vitrea* from very few records.

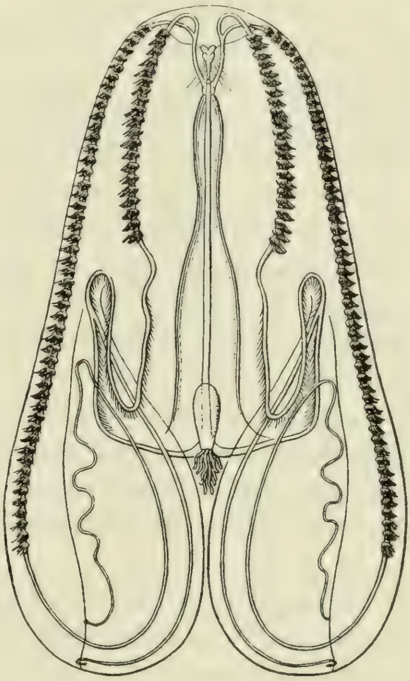

Fig. A. *Bolina vitrea.* Specimen from Acapulco, 82 mm. long. After a drawing from life. The musculature of the inner surface of the lappets is omitted.

The Acapulco specimens agree most closely with the accounts of *vitrea*, and particularly with Mayer's figures of that species. Like the latter they are comparatively slender in outline, the lappet-canals are but little convoluted, and the auricles are short. The only differences are that in our largest specimen (82 mm. long) the lappets are proportionately slightly shorter than Mayer shows them, that the subventral ribs extend further over the lappets (Fig. A), and that the canals and tentacular apparatus were amber-yellow instead of being colorless, or pink. But observation of the living specimens showed that the proportional length of stomach to lappets may change through wide limits from moment to moment as the animal contracts and expands. In a specimen 69 mm. long, at rest the proportion was almost exactly what A. Agassiz shows (**'65**, fig. 19). The slight difference in the length of the ribs may be nothing but a growth character at any rate it is too slight to be used as the basis for specific separation. There remains, then, only the question of color; and until the Pacific form is known from more than one locality, the importance of this must remain in doubt. It may be nothing more than a temporary physiological phenomenon controlled by food; and this would be the natural explanation did the canals alone show it, but the yellow color of the tentacular apparatus may be more significant. *B. vitrea* is described by A. Agassiz as wholly colorless. Two courses are open; to refer the specimens provisionally to *vitrea,* or to institute for them a new variety of the latter; the former will most satisfactorily express our present scanty knowledge.

One can not compare the Acapulco specimens with my (**: 04**) figure of *ovalis* without being struck by the likeness between the two; indeed the only apparent difference is that the latter, like *vitrea,* is colorless. My only reason for separating it from the latter was that the lobes were proportionately longer, the stomach shorter. Unfortunately the single specimen of *ovalis* was two fragmentary for accurate diagnosis. But its obvious resemblance to *vitrea* suggests at least the possibility that some variety of the latter will be found to be at home in the tropical and subtropical waters of all three great oceans.

A comparison between *vitrea* and *hydatina* shows that the two are closely allied in structural characters, *i. e.* they agree in the simplicity of the lappet-canals and short auricles. But to judge from Chun's figure (**'80**, taf. 4, fig. 5) the Mediterranean form is shorter, broader, and less flattened than *vitrea,* and the ribs are rather shorter. We have no account of the final stage in growth; the largest specimens observed by Chun being only 4 mm. long; *vitrea* attains a length of upwards of 70 mm. It may be that the differences in external form are growth characters, and that such is the case is suggested by the fact that I have compared small specimens from Acapulco with corresponding stages of *hydatina* from Naples, without finding a single character to separate the two. But it is hardly worth while to speculate further along this line until living or well preserved adult specimens from the Mediterranean are examined. I believe, however, that we can safely say that the closest relationship of *hydatina* is with *vitrea*, not with *infundibulum* as Mayer (:**12**) supposes.

Bolinopsis mikado, likewise, has short auricles and simple lappet-canals so far as the latter could be traced, but the sense-body is much more deeply sunken than in any other Bolinopsis; and the structure of the ribs further differentiates it. It is highly desirable that better material of this interesting species be studied. The same is true also of *elegans,* which is characterized, according to Mertens, by the presence of numerous papillae on the outer surface of the body, lacking in other species of Bolinopsis.

Bolinopsis chuni has been described in detail by Lendenfeld: its distinguishing features, as noted by Moser (:**08a**, p. 56), are the extraordinary thickness of the lappets, the simplicity of the lappet-canals, and by the fact that the gastric canals lie at some distance from the stomach.

BOLINOPSIS VITREA (L. Agassiz). Mayer.

Bolina vitrea L. Agassiz, '**60**, p. 269, 289, fig. 93; A. Agassiz, '**65**, p. 19, fig. 19; Mayer, :**00**, p. 81, pl. 27, figs. 91, 92; Moser, :**08a**, p. 53.

Bolinopsis vitrea Mayer, :**12**., p. 22, pl. 5, fig. 16–19.

Acapulco Harbor, 4 specimens, 10–82 mm. long.

Unfortunately I was unable to preserve any specimens. Although I tried various preservatives and various methods of stupefaction, all the bottles were found after the journey across the continent to contain nothing but a gelatinous mass of fragments. But as I foresaw from my experiences with *B. infundibulum* that this might happen, detailed drawings and notes were made from life, and the following account is based upon these.

1. *Adult.* Two large specimens, 82 and 69 mm. long, were taken and kept under observation for several hours. The largest, when at rest (Fig. A), lay with the lappets touching. In this position its longest diameter at the level of the top of the auricles was slightly half its length; and the lappets extended beyond the mouth for a distance equal to about $\frac{3}{8}$ of the length of mouth-pole. That is to say, the stomach was comparatively long. The auricles are short: they arise at the mid-level of the stomach, and do not quite reach the mouth, thus bearing the same relation to the gastric system that they do in

the Mediterranean *hydatina*. The ribs are, of course, unequal, the subgastric being very long, and extending over more than half the length of the lappets. And the paddle-plates are very numerous.

The course of the canals over the lappets is interesting, and was easily traced. The upper, *i. e.* pharyngeal, loop is more easily understood from the figure (Fig. A) than from a verbal description. It is much less complex than in *infundibulum*. In the latter, according to the descriptions of L. and of A. Agassiz the transverse trunk which connects the loop on either side is bowed in the middle in a pronounced double curve. But in the present specimen it is nearly direct, there being merely a slight curve in the mid-line. The descending branches of its two lateral loops are thrown into a series of small curves, but these vary in number on the two sides, and became more or less pronounced according as the animal expanded or contracted. In general the canals agree with those of Mayer's specimens. As in the other species the inner surfaces of the lappets are provided with a well-developed musculature of crossed fibres.

The funnel-canal is very short, and the adradial canals empty directly into the ends of the meridionals. The tentacular apparatus is of the usual bolinid type. The specimen of 69 mm. is proportionately broader than the one just described, and its lappets are longer, extending beyond the mouth for a distance equal to two thirds the polar length of the animal. That is to say, this specimen agrees very well in its proportions with Mayer's figures. Furthermore the auricles as in the latter, hung just beyond the mouth. When the animal contracted transversely with the folding of the lappets, it became elongated, and the stomach proportionately longer than when at rest. The course of the canals was the same as in the larger example, except for minor variations in the convolutions, which were less pronounced. It is evident, then, that the external proportions differ considerably at different stages in growth, or that they vary individually.

Two young specimens of Bolinopsis were taken. In the younger, 10 mm. long, the lappets have just appeared, but are still very short. In this respect the specimens agree with the young *infundibulum* shown by A. Agassiz ('65). But in other respects they are much further advanced, the ribs being longer, already with twelve paddle-plates in each of the tentacular, sixteen or seventeen in the pharyngeal; the stomach laterally flattened and of the adult triangular form, the lappet-canals, both inner and outer, complete, and the tentacular sheaths opening well below the level of the funnel, about mid-way between it and the mouth-level. No trace of the auricles is yet to be seen.

In an older stage of 20 mm. very similar to one shown by Mayer (**:12**, pl. 5, fig. 19) the lappets have grown longer, the lappet-canals already show the main loops of the adult, the tentacles now open at about the level of the mouth, though their canals still lie far from the oesophagus, and the young auricles are visible. The only apparent difference between these specimens and *infundibulum* of corresponding ages is that in the former the auricles appear before the lappet-canals are fully formed, whereas in the latter the reverse is the case.

CESTIDA.

CESTIDAE GEGENBAUR.

CESTUM Lesueur.

Up to the present time two species of Cestum have been described from the Pacific, *C. najadis* Eschscholtz, and *C. amphitrites* Mertens; but of neither is the status satisfactorily determined. *Cestum najadis* is distinguished from the Atlantic *veneris* by its possession of long tentacles of the cydippid type; and, according to Moser (**:08a**, p. 13), by its geographical occurrence. The latter reason can not be abandoned too soon, as I have already pointed out (**:09**) for similar cases among Medusae; but the former is of real value, if it can be depended upon. Unfortunately the animal is known from the original description only. And it would be so remarkable for a cestid to have long tentacles, that we may be pardoned if we hesitate to accept the account until it is verified. There is another difference between *najadis* and *veneris* which has not been emphasized previously, namely that the tentacle-bases are yellow in the former, colorless in the latter. In this respect *najadis* agrees with *amphitrites*, but here again we are confronted by the question of the structure of its tentacles.

Cestum amphitrites was so beautifully figured by Mertens (**'33**) that we can gain a very good idea both of its anatomy and of its general appearance in life. Color proves a very obvious difference between it and *veneris*, for whereas the latter is colorless, the tentacular bases of the former are brownish yellow, and there is a spot of the same color at either extremity of the band-like body. Anatomical differences were thought to exist by Mertens (**'33**, p. 493) namely the presence of "zwei Blättchen die das Stigma. . . . einfassen" and of "zwei bandförmige Kanten. . . . die an beiden Flächen, der oberen wie der untern, durch die ganze Ausdehnung des Thieres verlaufen." But the first of these seem to be nothing but the rounded gelatinous prominences which Chun has figured for *veneris* (**'80**, taf. 13, fig. 4). And as for the latter, I can find nothing in Mertens's figure which I can thus identify, and therefore am in some doubt as to just what was meant.

The only structural feature which may separate *amphitrites* from the Atlantic form is a slight apparent difference in the relations of adradial to meridional canals. But Mertens's figure (**'33**, pl. 1, fig. 5) is obviously somewhat diagrammatic, and not altogether clear. I have considered *amphitrites* thus fully because a single Cestum was taken which agrees with Mertens's figure in color, as well as in its general form and structure, and which may therefore be identified safely as *amphitrites*. Anatomically I was able to find nothing to differentiate it from *veneris*: it agrees even in the proportions of the various organs and canals; but unfortunately parts of the canals were destroyed.

Whether *najadis* can be referred to *amphitrites*, as its color suggests, is doubtful, as pointed out above. There is one other Cestum the color of which suggests that it probably does belong there, namely *C. pectenalis* Bigelow from the Maldives. Moser (**:08a**) has pointed out that my description of that species was unsatisfactory; and I can go farther and say that the account, my first attempt at zoölogical description, was founded on insufficient notes, and is therefore practically worthless. I have recently referred to my original drawings (no specimens were preserved) and would state that the only details which can be depended on are the general form and the yellow spots at either extremity.

CESTUM AMPHITRITES Mertens.

Cestum amphitrites Mertens, **'33**, p. 492, taf. 0; L. Agassiz, **'60**, p. 291.

Cestus veneris Chun, **'80**, p. 301 (partim).

Cestus amphitrites Moser, **:08a**, p. 14.

?*Cestus pectenalis* Bigelow, **:04**, p. 267, pl. 8, fig. 30.

Station 4546 Hyd. (14° 50′ N. lat., 101° 31′ W. long.).

One specimen, about 60 cm. long was taken, and several others were floating on the surface.

The specimen was in good condition, except for some damage to the canals, and was kept under observation alive for some time. It was then preserved in formalin, but fell into fragments during the journey home. So far as its general anatomy is concerned it agrees very well with a somewhat smaller specimen of *veneris* from Naples, with which I have compared it. The polar length, in life, was about 45 mm., and the body tapered gradually to the extremities, which were rounded, as in *veneris.* The only noticeable difference in form is that the oral margin of the band-like body is about as broad as the aboral margin. In *veneris* it is much narrower, so that a cross-section, taken at either side of the stomach is roughly triangular (Chun, '80, taf. 13, fig. 3). In the present specimen such a cross-section would be roughly rectangular. But in both, the body is broadest along the lines of the subtentacular meridional canal.

The subgastric ribs closely resemble those of *veneris,* the paddle-plates being closely crowded and very numerous, and sexual products were visible for the entire length of the subventral meridional canals. I could not determine definitely whether or not there were any paddle-plates in the subtentacular canals, as the critical region was damaged; but there were four agglutinated masses of cilia which lay in positions corresponding to the subtentacular plates of *veneris,* and they should probably be identified with the latter. The stomach was about 32 mm. long, the funnel-canal only about 6 mm.; the proportions between the two thus being about the same as they are in *veneris.* The junction of adradial with meridional canals could not be traced.

Tentacles. The tentacles, as in *veneris,* lack axial filaments, and consist of a large number of filiform tentilla arising from the swollen base. The tentacular sheaths are about one half as long as the polar length. The "Tentakelrinne" bear filamentous tentilla throughout their length.

The most striking specific character of *amphitrites* is its color. The tentacle-bases are chrome to amber-yellow; the subtentacular meridional canals show as lines of the same color throughout their length; and at each extremity there is a spot of somewhat darker yellow. These spots were common to all the specimens we saw, making them very conspicuous in the water. But though so noticeable, they, and the color-bands along the meridional canals, have disappeared with preservation, the yellow tint of the tentacles alone persisting.

GEOGRAPHICAL DISTRIBUTION.

Moser's (:**09**) recent discussion of the geographical distribution of the Ctenophores is so thorough that it will no doubt form the starting point for all future work along this line, and Mayer (:**12**) has given a valuable account of the occurrence of the group on the east coast of North America. But inasmuch as the Eastern Tropical Pacific, so far as its Ctenophores are concerned, was practically a blank on the map, until visited by the "Albatross," our records are of considerable importance in their relation to Moser's general conclusions. They help to fill in a very large geographic gap. There were only two species, viz., *Hormiphora palmata* and *Beroe forskalii,* which occurred often enough to show the regularity of their distribution within the area examined. The former was taken on all our lines, and its occurrences (Plate **2**) were sufficiently numerous to show that it is a characteristic and typical member of the pelagic fauna of the Eastern Tropical Pacific. It is noteworthy that it was not encountered in the colder waters of the Humboldt Current close to the Peruvian coast, on either of our two southern lines. This may have been a coincidence; indeed, equally broad gaps may be seen on other lines. But it is an interesting fact that it was not the only common surface form found on all our lines, but absent from the cold-coast water traversed on the two southern sections of the Humboldt Current. Practically the same distribution was true of several Siphonophores (Bigelow, :**11**).

Moser's record of *H. palmata* (= "*japonica*") from Japan is especially interesting because so far as the locality, Sagami Bay, shows, it might belong to either the cold- or the warm-water fauna. The oceanographic conditions along the east coast of Japan have been explained in a very lucid way by Doflein (:**06**), who himself noticed a startlingly rapid and complete change in the surface fauna in Sagami Bay from days when the warm waters (22–24° C.) of the Kuroshiwo Current swept into it, to others when they were replaced by cold water (15–18° C.) after north and northwest winds. In the former case he collected a typical tropical fauna, including such genera as Cestum, Porpita, Forskalea, Physalia, Janthina, Philliroe, and Carinaria. In the latter these were entirely lacking and in their places were found northern copepods and diatoms.

Now, in turning to Moser's (:**08a**) list of Japanese Ctenophores collected by Doflein, we find that Cestum was taken at the same locality, and on the same date as Hormiphora. And the "Albatross" captures in Japanese waters were all from temperatures above 72° F. For these reasons, and because all other records of *H. palmata* or of the forms so closely allied to it that I regard them as synonyms, are from temperatures above 21° C., we can safely conclude that this species is brought to the coast of Japan by the warm water of the Kuroshiwo Current. On the west coast of America, the "Albatross" records carry *H. palmata* as far north as lat. 20°; but it is probable, though not absolutely certain, that this species was taken at San Diego by Torrey (p. 380). Judging from surface temperatures, it might have been expected to occur perhaps as far north as Santa Barbara Channel where the first noticeable admixture of northern coelenterates has been observed (Fewkes, **'89**). But it was not found in San Francisco Bay by A. Agassiz, who would hardly have overlooked it had it been a characteristic member of the surface fauna in that region. And, from the standpoint of temperature, we would hardly expect a tropical form to occur there.

The genus Hormiphora, except for *H. cucumis,* is confined to tropical and subtropical waters so far as the records yet show. The coldest record for any recent specimen is 64° F.; in the case of one *H. ochracea* taken by the "Albatross" in 1900, lat. 31° 10′ N., long. 125 W., but *cucumis* is known from off the coast of Alaska, between Sitka and Unalaska, in a temperature of about 45°. It is not likely that so conspicuous a form would have escaped notice, did it occur in the temperate or colder parts of the Atlantic, for example the Labrador Current, the North Sea, the northern coast of Europe, or in New England waters.

Beroe forskalii was not taken so often as Hormiphora, but the position of occurrence, together with the previous records from the coasts of southern California, from Fiji, from the Ellice Islands, Hawaii, the Malay Islands, and the Maldives, show that it is very generally distributed over the tropical Indo-Pacific, as it is in the Atlantic. This species is not known from cold currents in the Atlantic, though as I have pointed out above (p. 388), it is recorded from the Antarctic.

Another form which is so far known from warm regions only is *Bolina vitrea.* Up to the present time this species, whose validity seems assured, was known only from the southeastern shores of the United States. But the "Albatross" records show that it also occurs in the Tropical Pacific; and it is probably recorded from the Indian Ocean (p. 392). The captures of Pandora extends the range of that form to the Eastern Tropical Pacific. Discovered in Japan only six years ago, Moser (: **09**) has already recorded it from the tropical Atlantic, the south Atlantic, and the neighborhood of Cape Town. And it is not only the wide separation of these localities which is striking, but the fact that the few records yet obtained already extend its temperature range from 58.6° F. to 79° F. is even more important as showing over how broad a range it may be expected. I may likewise emphasize the occurrence of *Pleurobrachia pileus* in Acapulco Harbor, at a temperature of 83° F. Moser (: **09**) speaks of this species as a northern form, and uses this as an argument against uniting Graeffe's Pleurobrachia from Trieste with it. When a species occurs from the Arctic to lat. 34° N. in the north Atlantic; along the west coast of America from Puget Sound to Acapulco, at the Seychelles; at various South African localities, and very generally in the Antarctic; when it thus runs through the entire gamut of oceanic temperatures, it would not be surprising to find it anywhere. And, as a matter of fact, it does occur in the Mediterranean (p. 372). It is truly cosmopolitan, as it is classified in Moser's list. But though its range reaches from pole to pole, it is a much more important constituent of the Arctic and Subarctic than of the tropical plankton. In the colder Atlantic currents it is regular in occurrence, and often extremely numerous; in the tropics it is recorded only occasionally, and usually from small specimens.

The "Albatross" discovered no local species of Ctenophores. All her captures extend the range of previously known forms, but they afford some evidence that at least one genus, Cestum, has one tropical species in the Indo-Pacific, another in the Atlantic; though the case is not yet altogether clear. There is no evident reason why this should be the case, when one species of Hormiphora extends over both oceans, but I may point out that there is an Atlantic and a Pacific species of Physalia, of Porpita, and probably of Velella, whereas most tropical Siphonophores are cosmopolitan in waters of suitable temperatures.

To sum up:— the "Albatross" collection lends important support to Moser's generalization that the Ctenophores as a whole are animals of wide distribution; and it reduces by one, *Pleurobrachia rhodopsis*, the list of forms so far known only from restricted localities. It also rescues from obscurity one of the old species, *Cestum amphitrides* Mertens.

In the accompanying map (Plate **2**) the occurrence of Ctenophores is plotted for the eastern half of the Pacific, only records of the specific identity of which there is no reasonable doubt being included. For the various doubtful forms, see Moser (:**09**). To illustrate how nearly virgin the region previously was, I may point out that of the forty-eight records all but eleven (Moser, :**09**, taf. 22) are from the collections of the "Albatross"; and only three were previously made in the oceanic quadrangle where the "Albatross" did her actual work in 1904–1905; *i. e.*, from about 20° N. to 24° S.; and from 80° W. to 135° W.

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PLATE 1.

Hormiphora palmata.

Fig. 1. Side view of specimen 24 mm. long, in tentacular plane, with the pharyngeal rows of paddle-plates dissected away to show internal anatomy.

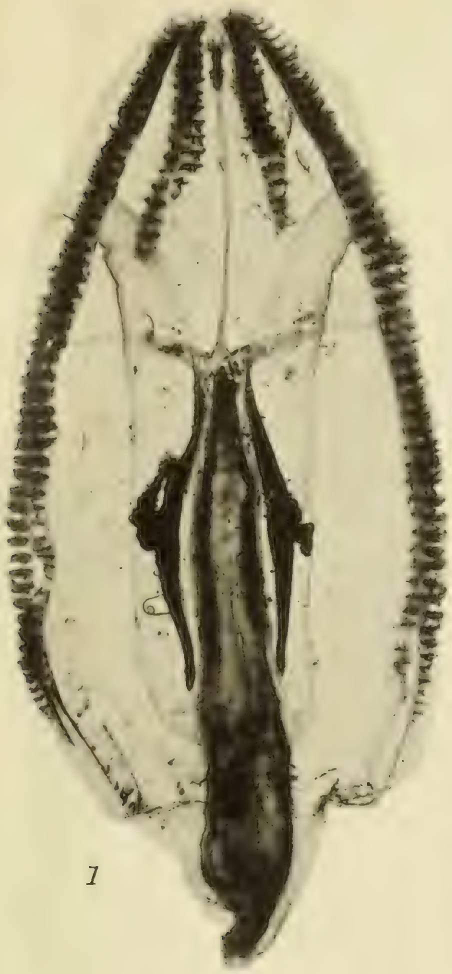
Fig. 2. Side view in tentacular plane of somewhat contracted specimen 18 mm. long, similarly dissected.

Fig. 3. Side view in pharyngeal plane of specimen 24 mm. long.

Fig. 4 Portion of specimen 28 mm. long, from Japan, to show the form of the bases of the tentacles.

Fig. 5. Pharyngeal view of oral portion of specimen in fig. 2, to show the relative lengths of ribs, meridional canals, and tentacular sheaths.

Fig. 6. Similar view of specimen shown in fig. 3.



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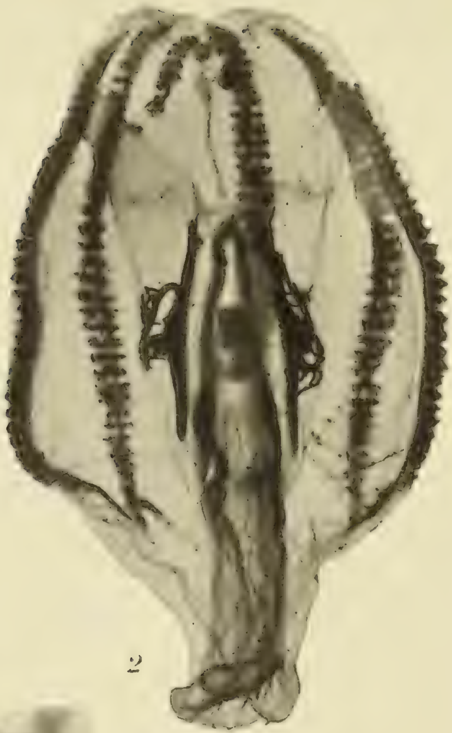

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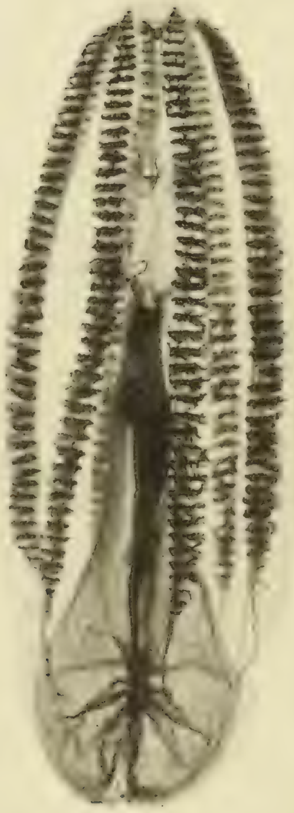

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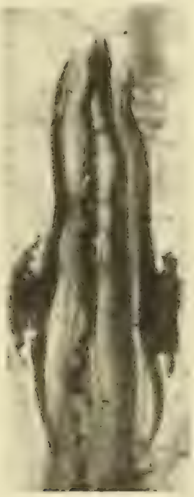

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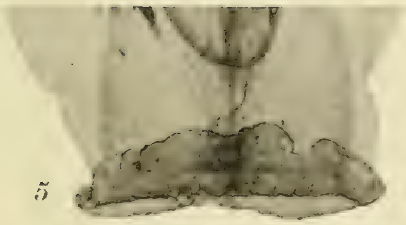

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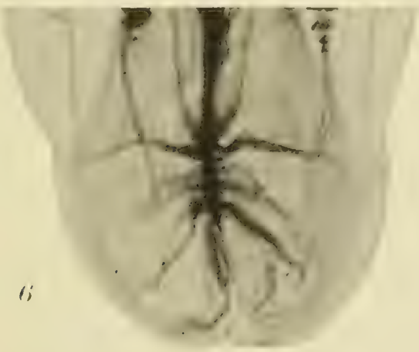

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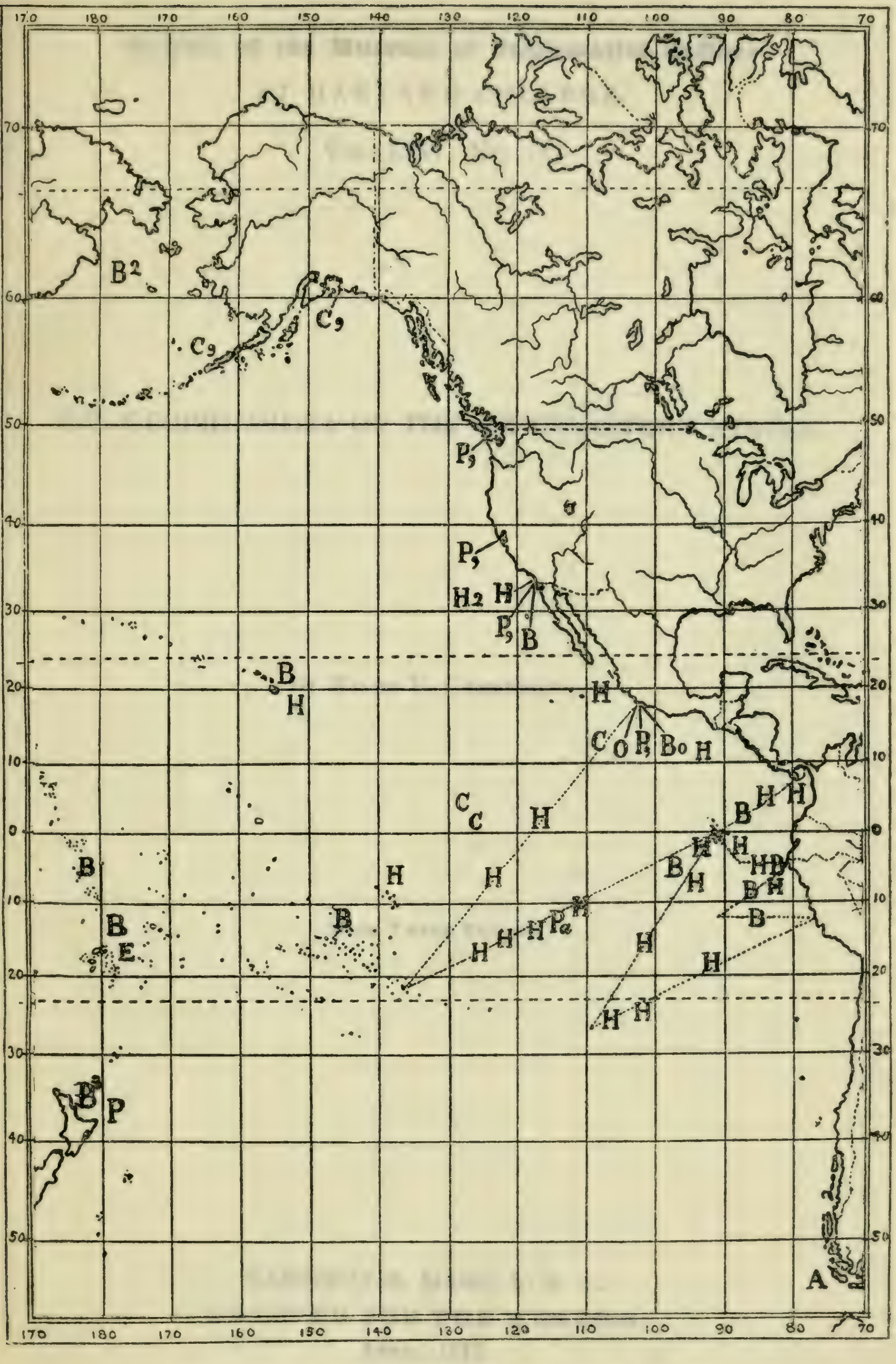
H. B. B. PHOTO. HELIOTYPE CO., BOSTON

PLATE **2**.

Chart of the eastern part of the Pacific, showing records of Ctenophores. The dotted line is the course of the "Albatross," 1904–1905. Only records of well-established identity are included.

A = Calliarina antarctica.
B = Beroe forskalii.
B^2 = Bolinopsis septentrionalis.
B^3 = Beroe clarkii.
B^0 = Bolinopsis vitrea.
C = Cestum.
C, = Hormiphora cucumis.
E = Eucharis.
H = Hormiphora palmata.
H^2 = Hormiphora ochracea.
P = Pleurobrachia pileus.
P, = Pleurobrachia pileus var. bachei.
Pa = Pandora mitrata.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Distribution of Ctenophores in Eastern Pacific.

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
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THE GEOPHILOIDEA OF THE SOUTHEASTERN STATES.

By Ralph V. Chamberlin.

With Three Plates.

CAMBRIDGE, MASS., U. S. A.:
PRINTED FOR THE MUSEUM.
April, 1912.

No. 13.— *The Geophiloidea of the Southeastern States.*

By Ralph V. Chamberlin.

Our knowledge concerning the Chilopoda of the southeastern section of the United States has long been so meager and fragmentary, that it is considerable satisfaction to present a revision of the Geophiloidea of the region based upon the study of rather extensive material. Most of this material was secured by the author himself through systematic collecting carried out during the summer of 1910, every section of the region being visited excepting southern Florida (which, as belonging rather to another fauna, is not included) and the coastal portions of Georgia and the Carolinas. It has been possible to ascertain somewhat clearly the limits of distribution of a number of important species together with the range and directions of their variations and thereby to bring about simplification through the relegation to synonymy of many names given to forms of non-specific grade. All the species previously recorded from the region were secured, as well as representatives of a number of undescribed ones, among which are the types of two genera for which it seems necessary to erect a new family. Of importance, also, was the rediscovery of Bollman's *Scolioplanes gracilis,* later made the type of the genus Agathothus, the affinities of which have for twenty years been in doubt, no diagnosis having heretofore been published.

Dr. Meinert's types of North American species in the collection of the Museum of Comparative Zoölogy have been available for study and comparison during the preparation of this paper. The types of the new species are also in the collection of the Museum.

The following list is introduced by way of summary; synonyms are printed in italics.

GEOPHILIDAE.

GEOPHILINAE.

Polycricus Humbert and Saussure.

P. floridanus Cook = P. marginalis (Meinert).
P. marginalis (Meinert).

PACHYMERIUM C. L. Koch.

P. ferrugineum (C. L. Koch).
P. foveatum (McNeill) = P. ferrugineum (C. L. Koch).

ARENOPHILUS, gen. nov.

A. attenuatus (Say) = ? bipuncticeps (Wood).
A. bipuncticeps (Wood).
A. georgianus (Meinert) = A. bipuncticeps (Wood).
A. latro (Meinert) = A. bipuncticeps (Wood).
A. perforatus (McNeill) = A. bipuncticeps (Wood).
A. unaster Chamberlin.
A. watsingus, sp. nov.

GEOPHILUS Leach.

G. atopleurus Chamberlin = G. mordax Meinert.
G. cephalicus Wood = G. rubens Say.
G. huronicus Meinert.
G. laevis Wood = G. rubens Say.
G. lanius Brölemann = varians McNeill.
G. legiferens Chamberlin.
G. louisianae Brölemann = mordax Meinert.
G. mordax Meinert.
G. rubens Say.
G. salemensis Bollman = G. mordax Meinert.
G. varians McNeill.
G. virginiensis Bollman = G. mordax Meinert.

CHILENOPHILINAE.

WATOPHILUS, gen. nov.

G. alabamae, sp. nov.

GNATHOMERIUM Ribaut.

G. americanum Ribaut = G. umbraticum (McNeill).
G. umbraticum (McNeill).

LINOTENIINAE.

LINOTENIA C. L. Koch.

L. bidens (Wood).
L. bothriopa (Wood) = L. fulva (Sager).
L. branneri Bollman.
L. chionophila (Wood) =? branneri Bollman.
L. fulva (Sager)
L. robusta (Meinert) = L. fulva (Sager).
L. ruber Bollman = L. bidens (Wood).

AGATHOTHUS Bollman.

A. gracilis Bollman.

SOGONIDAE, fam. nov.

SOGONA, gen. nov.

S. minima, sp. nov.

TIMPINA, gen. nov.

T. texana, sp. nov.

HIMANTARIIDAE.

GOSIPHILUS Chamberlin.

G. laticeps (Wood).

HAPLOPHILUS Verhoeff.

H. grenadae, sp. nov.

The families recognized as occurring in the region may be separated by means of the following key.

Key to families.

a. Mandibles with a single pectinate lamella, and with no dentate lamella.
  b. Antennae flattened, attenuated distad; labrum of one piece which is fused mesally and free laterally. *Sogonidae,* fam. nov.

bb. Antennae filiform or somewhat clavate; labrum tripartite, entirely free. *Geophilidae.*

aa. Mandibles with one dentate lamella and with several pectinate lamellae. *Himantariidae.*

GEOPHILIDAE.

This large family as represented in the southeastern states embraces three subfamilies: — the Geophilinae, including the genera Polycricus, Pachymerium, Arenophilus, gen. nov., and Geophilus; the Chilenophilinae, including Watophilus, gen. nov. and Gnathomerium; and the Linoteniinae, including the genera Linotenia and Agathothus. These groups and genera, so far as affects the species here dealt with, may be separated as follows.

Key to subfamilies and genera.

a. Median piece of labrum very large, armed with a fringe of teeth or spines; lateral pieces small, free edge smooth, unarmed. *Linoteniinae.*

  b. Claw of prehensors unarmed; conspicuously excavated at proximal end dorsally, constricted. *Agathothus* Bollman.

  bb. Claw of prehensors armed within with a single large tooth; not excavated proximally. *Linotenia* Koch.

aa. Median piece of labrum relatively very small, the lateral pieces large and with the free edge armed with few to many spinescent processes.

  b. Second maxillae with a very strongly chitinized oblique, pleurosternal suture. *Chilenophilinae.*

    c. Middle piece of labrum completely separating the lateral; anal legs clawless, with seven articles beyond coxopleura. *Watophilus,* gen. nov.

    cc. Middle piece of labrum not separating the lateral; anal legs armed with claws, having six articles beyond the coxopleura. *Gnathomerium* Ribaut.

  bb. Second maxillae without any such chitinous suture. *Geophilinae.*

    c. Prehensorial feet mostly not extending beyond anterior margin of head, the joints unarmed within or only obscurely so (last ventral plate mostly wide to very wide). *Geophilus* Leach.

cc. Prehensorial feet much exposed from above, extending well beyond anterior margin of head, the joints distinctly denticulate within; (last ventral plate either wide or narrow).
  d. Last ventral plate very wide; coxopleural pores aggregated and opening into two large pits on each side adjacent to or covered by edge of last ventral plate; anal legs clawless, composed of seven articles beyond coxopleura. *Arenophilus,* gen. nov.
  dd. Last ventral plate narrow; pores of coxopleura not aggregated and opening into pits; anal legs with six joints beyond coxopleura (with or without claw).
    e. Ventral pores in four areas, two on anterior portion of plate and two on posterior; (anal legs in ours clawless). *Polycricus* Humbert and Saussure.
    ee. Ventral pores not in four areas in this way; anal legs with claws. *Pachymerium* Koch.

GEOPHILINAE.

GEOPHILUS Leach.

Trans. Linn. soc. London, 1814, **11**, p. 384.

The species recognized as occurring in the southeastern states may be separated by means of the following key.

Key to species.

a. Frontal plate discrete.
  b. Prebasal plate exposed.
    c. Coxopleurae of last pediferous segment with two large pits which are covered by the last ventral plate. *G. rubens* Say.
    cc. Coxopleurae of last segment with from five or six to many small pores. *G. mordax* Meinert.
  bb. Prebasal plate not exposed.
    Pairs of legs — sixty-one or close thereto. *G. legiferens* Chamberlin.
aa. Frontal plate not discrete.
  b. Prebasal plate not exposed.
    c. Last ventral plate wide. *G. huronicus* Meinert.
    cc. Last ventral plate narrow. *G. varians* McNeill.

GEOPHILUS RUBENS Say.

Journ. Acad. nat. sci. Phil., 1821, **2**, p. 21.

Geophilus cephalicus Wood, Journ. Acad. nat. sci. Phil. 1862, ser. 2, **5**, p. 44.

Geophilus laevis Wood, ibid. Trans. Amer. philos. soc., 1865, new ser., **13**, p. 180.

Strigamia rubens Wood, Trans. Amer. philos. soc., 1865, new ser., **13**, p. 182.

LOCALITIES.— Virginia, near Washington, D. C.; Raleigh, N. C. (seq. Brölemann).

Contrary to the usual supposition, this species, so abundant in the more northern states, is very rare in the greater part of the South, or, rather, wholly absent.

GEOPHILUS MORDAX Meinert.

Proc. Amer. philos. soc., 1886, **23**, p. 218.

Geophilus salemensis Bollman, Entom. Americana, 1887, **3**, p. 82.

Geophilus virginiensis Bollman, Proc. U. S. N. M., 1889, **11**, p. 346.

Geophilus louisianae Brölemann, Ann. Soc. ent. France, 1896, **65**, p. 55.

Geophilus atopleurus Chamberlin, Ann. Ent. soc. America, 1909, **2**, p. 181.

LOCALITIES.— Watervalley, Holly Springs, Grenada, Gulfport and Longbeach, Miss.; Louisiana; Maplesville and Thomasville, Ala.; Raleigh, Marion, Salisbury, and Hot Springs, N. C.; Unaka Springs, Tenn.; Virginia, near Washington, D. C.

This is a common and conspicuous species in the Southern States, where it appears to replace *G. rubens* Say of the states farther north, a species probably very closely related. The present species is subject to considerable variation in size, coloration, and in the number and arrangement of the pleural pores though the latter uniformly present certain distinctive features. Typically, the individuals of this species are in life distinctly red, the coloration being almost precisely that of many or most Linotenias, such as *L. fulva* and *L. bidens*. Occasionally the red is less dense, the color being pinkish or the more ordinary yellowish brown. In alcohol the red color quickly fades. The characteristic structure of the head and prehensorial feet and the conspicuous pits at cephalic edge of the anterior sterna with the corresponding processes of the caudal margins are features by which the species may readily be recognized when taken in connection with the shape of the last ventral plate and the nature of the coxopleural pits. Mr. Bollman established *G. virginiensis* chiefly on the presence of these sternal pits in his type; but he must not have had specimens which he recognized as *G. mordax*, for the type of this species, which I have recently examined, together with all the other specimens studied, have these pits plainly showing, though in some few they are less conspicuous and may be overlooked when the sterna are closely articulated. Mr. Bollman also suggests a difference in the proportions of the "coxa" of the prehensorial feet. As to *mordax*, Meinert says: "sternum....sesqui latius quam longius, coxa fere duplo longius (20: 11)." Mr. Bollman appears uniformly in constructions corresponding to this in Meinert's various descriptions to have taken the *longius* as being in agreement with coxa; but plainly the comparison is between length of sternum and that of coxa, not between length and breadth of the latter. A cotype of *G. salemensis* which I have examined is also a large specimen of *mordax* in which the sternal pits are conspicuously developed though they appear to have been overlooked by Mr. Bollman.

Of the coxopleural pores one is typically somewhat larger than the others and more or less isolated on the more caudal portion of the coxopleurae, the others being cephalad of it. In medium sized individuals the pores are usually scattered over the surface of the coxopleurae; but with increasing age there is a distinct tendency for the pores to become crowded along the edge of the ventral plate in mostly two rows and similarly along the dorsal plate, leaving the greater portion of the coxopleural surface free from pores excepting for the single isolated one. Often the ventral pores, excepting this single one, become shifted entirely beneath the edge of the ventral plate and the dorsal ones similarly beneath the dorsal plate. At the same time there is a tendency for some pores to close up and disappear in later moults, so that there results a progressive reduction in the number of pores. Brölemann's *G. louisianae* is clearly based upon an old individual of *mordax* in which the pores are thus somewhat reduced in number and covered by the ventral plate excepting for the single one. In a few individuals, quite old as judged by the appearance of the head, which have been studied there appears a tendency for the isolated pore to become reduced and then closed. In the form described by the writer as *atopleurus* there is no single pore but in its place a peculiar chitinous thickening that at first appears like a minute tooth or spine. In a number of additional specimens in this condition taken in Mississippi, the characteristics upon which the original was separated as a species are well marked. The chitinous marks are in shallow depressions and after a careful study of them, I conclude that they represent the completely closed pores, the lines being the appressed and fused margins of the pore. This condition appears to be rare.

There is considerable variation in the anal pores, these being usually less readily distinguishable in older individuals than in young and partly grown ones. In fact, they seem in some old specimens to have become grown over and closed. Hence the possibility of Meinert's statement "Pori anales nulli." In the great majority of individuals, however, the pores are distinct, though often not readily seen from ventral view.

GEOPHILUS LEGIFERENS Chamberlin.

Ann. Ent. soc. America, 1909, **2**, p. 182.

LOCALITY.— Virginia, near Washington, D. C.

GEOPHILUS HURONICUS Meinert.

Proc. Amer. philos. soc., 1886, **23**, p. 220.

LOCALITY.— Russellville, Tenn.

A northern species. The specimens from Russellville agree in all essential points with Meinert's types, with which they have been directly compared. The next species, *varians*, is at least very close also, the main difference being in the last ventral plate which is much narrower than that of typical *huronicus*.

GEOPHILUS VARIANS McNeill.

Proc. U. S. N. M., 1887, **10**, p. 332.

Geophilus lanius Brölemann, Ann. Soc. ent. France, 1896, **65**, p. 51.

LOCALITIES.— Raleigh, N. C. (Brölemann); Indiana.

Only the type specimens known.

POLYCRICUS Humbert and Saussure.

Etudes sur les Myriop., 1872, p. 143.

One species within our range apparently referable to this genus is known from Florida.

POLYCRICUS MARGINALIS (Meinert).

Geophilus marginalis Meinert, Proc. Amer. philos. soc., 1886, **23**, p. 218.

Polycricus floridanus Cook, Proc. Ent. soc. Washington, 1899, **4**, p. 307.

LOCALITIES.— Key West, type locality and Miami (J. H. Comstock), Fla.

The specimen from Miami agrees fully with Meinert's type.

PACHYMERIUM C. L. Koch.

Syst. d. Myriopoden, 1847, p. 85 and 187.

PACHYMERIUM FERRUGINEUM (C. L. Koch).

Geophilus ferrugineus C. L. Koch, Deutsch. Crust. Myr. Arach., 1835, **3**, p. taf. 2.

Mecistocephalus foveatus McNeill, Proc. U. S. N. M., 1887, **10**, p. 333.

Geophilus attenuatus Cook (nec. Say), Proc. U. S. N. M., 1895, **18**, p. 59.

LOCALITIES.— Holly Springs and Watervalley, Miss.; New Orleans, La.; Jackson, Ala.; Asheville, N. C.

A female with very recently hatched young was taken, among numerous specimens, at Asheville on Aug. 6. Apparently, however, most of the females, at this place, leave their young considerably earlier in the season, many young being found some way along in development.

While the species is often found under bark of trees and beneath leaves, I have taken it by far in greater numbers under stones along river courses. At New Orleans it was found very abundant in a vacant lot upon which there were piles of stones and pieces of bricks, beneath which it occurred. At Wisconsin it was found early in July in great abundance under stones and gravel at the edge of a stream, females with young still in the nest, partly grown young as well as many isolated adults being taken. This seems a favorite location for them, at any rate during the summer season.

This is a wide-spread species in the northern as well as in the southern states; but in the latter region it is by no means so common as *A. bipuncticeps*, *G. umbraticus*, *G. mordax*, or even *A. watsingus*. Where found, however, a considerable number of specimens were usually secured, the individuals almost swarming in several limited areas. The specimens secured are all small, like those of Austria-Hungary as described by Dr. Latzel; they vary from 15 to 35 mm. in length with but few approaching the upper limit, the greater number by far being under 25 mm. The number of legs in the specimens that were examined for this feature ranged from 41 to 47 pairs.

ARENOPHILUS, gen. nov.

Prebasal plate not evident; frontal suture absent. Basal plate trapeziform, strongly narrowed cephalad.

Labrum, free, tripartite; the middle piece fully separating the lateral, armed with a series of small teeth or teeth-like processes; the lateral pieces with a fringe of numerous long, slender spinescent bristles or processes.

First maxillae nearly as in Geophilus; the coxae completely fused at middle and separated from distal divisions by suture; palpi, biarticulate, coxae and femora with long membranous lappets at distal external angles.

Second maxillae without pleurosternal sutures; palpus triarticulate, without processes at distal end of femur.

Coxosternum of prehensors without chitinous lines or but weakly indicated. Prehensorial feet large, much exposed from above, extending cephalad well beyond anterior margin of head; articles distinctly denticulate within.

Ventral pores condensed, in definite areas, numerous.

Last ventral plate, wide. Coxopleural pores aggregated and opening into two large pits on each side which are mostly covered in whole, or in part, by the last ventral plate.

Anal pores present.

Anal legs unarmed; at distal end a very small seventh article.

TYPE.— *Geophilus unaster* Chamberlin.

Three species from the present region are referable to this genus. They may be separated as follows.

Key to species.

a. Ventral pores in a median longitudinal lanceolate area, the apex cephalad. *A. unaster* Chamberlin.
aa. Ventral pores not in a median longitudinal lanceolate area.
b. Ventral pores in a transverse area extending across the plate, or nearly so, in front of caudal edge. *A. bipuncticeps* (Wood).
bb. Ventral pores in a median circular or subcircular area. *A. watsingus,* sp. nov.

ARENOPHILUS UNASTER Chamberlin.

Ann. Ent. soc. America, 1909, **2**, p. 179.

LOCALITY.— Austin, Texas (J. H. Comstock and T. H. Montgomery, coll.).

While not actually taken within the region strictly covered by the present paper, it is likely to occur and is introduced in the key for purposes of comparison with *A. bipuncticeps,* and others, with which it is very closely related and perhaps cognate, *A. watsingus* also bearing a similarly close relation. *G. aster* is a large form conspicuously different from these related forms in the arrangement of the ventral pores. These occur on the anterior ventral plates in the form of a lanceolate area with the point cephalad, the area extending from the caudal margin the greater distance across the plate. All Texas specimens which I have seen are very constant in this character. *A. unaster* appears completely to replace *bipuncticeps* and *watsingus* in this region where it seems to be abundant.

ARENOPHILUS BIPUNCTICEPS (Wood).

Geophilus bipuncticeps Wood, Journ. Acad. nat. sci. Phil., 1862, ser. 2, **5**, p. 45. Trans. Amer. philos. soc., 1865, new ser., **13**, p. 180.

? Geophilus attenuatus Say, Journ. Acad. nat. sci. Phil., 1821, **2**, p. 114. Bollman, Proc. U. S. N. M., 1889, **11**, p. 347; Bull. 46, U. S. N. M., 1893, p. 14.

Geophilus georgianus Meinert, Proc. Amer. philos. soc., 1886, **23**, p. 219.

Geophilus latro Meinert, Myr. Mus. Haun., 1871, **1**, p. 79.

Schendyla ? perforatus McNeill, Proc. U. S. N. M., 1887, **10**, p. 325.

LOCALITIES.— Holly Springs, Byram, Fernwood, Hudsonville, Grenada, Canton, Jackson, Biloxi, Ocean Springs, Longbeach, Gulfport, Miss.; Selma, Jackson, Birmingham, Anniston, and Mobile, Ala.; Lula, Ga.; Russellville, Tenn.

The ventral pores in this species are numerous and conspicuous. They are arranged in a transverse area extending entirely across the plate immediately in front of the caudal margin, the area being mostly in the form of a very low triangle with the apex caudad; more rarely, it is in the form of an elongate, narrowly diamond-shaped area. This character may be detected even in very young specimens.

The type of *G. georgianus* I find to be a medium sized female agreeing fully with *bipuncticeps.* Meinert is in error in saying no anal pores are present. The anal pores in grown individuals are usually to be seen well only in lateral view. The opening lies in a depression and varies considerably in size, and, because of expansion of the canal, more so in appearance than in actuality, sometimes appearing very large where the tegument is transparent. *A. latro* of Meinert is based upon an individual in which the pores appear large, but it seems clearly this species. In other cases the folding of the tegument may so cover the pores that they are detected with difficulty and might be supposed to be absent (*A. georgianus* Meinert). Of *A. latro* I have not seen the original types; but in the Museum of Comparative Zoölogy there are four specimens determined by Meinert which are doubtless equally authentic.

ARENOPHILUS WATSINGUS, sp. nov.

Strongly attenuated caudad, less strongly cephalad; in general very sparsely provided with straight hairs which are moderate to long.

Body and legs yellow, the antennae a little darker. Head and prehensorial feet with prosternum light reddish brown. Cephalic plate much longer than wide (31:22), six times longer than the exposed portion of the basal plate in type specimens, but varying somewhat in others; subtruncate anteriorly and posteriorly, the sides nearly straight excepting at anterior and posterior ends where they bend obliquely mesocephalad and mesocaudad respectively, the caudal oblique portion being longer than the anterior. Frontal plate not discrete. Cephalic plate on caudal portion with two long sulci which run cephalad from caudal margin and diverge a little; glabrous or nearly so, there being a very few bristles (see Plate 1, fig. 1). Exposed portion of basal plate at middle considerably more than four times as wide as long (4.4:1), being considerably overlapped by cephalic plate, at sides the length $\frac{1}{3}$ the width (Plate **1**, fig. 2).

For labrum see Plate **1**, fig. 4. Lappets of first maxillae large, membranous.

Antennae long to very long, all articles long excepting a few before the ultimate; ultimate article clearly shorter than the two preceding together (5:4); most articles clothed with a limited number of long straight bristles subdefinitely arranged, the distal articles becoming densely clothed with finer, shorter, straight hairs.

Claws of prehensorial feet when closed extending much beyond cephalic margin of head but not fully attaining the distal end of first antennal article. The claw with a small, subcylindrical, blunt tooth at base; first joint with a very low, obtuse denticule; other joints and prosternum unarmed. Prosternum with anterior mesal margin widely but only weakly sinuate; subquadrate; wider than long in about ratio 20:17, considerably less than twice as long as the coxa (32:21); coxopleural suture subparallel with lateral margin, curving mesad a little in going caudad. Chitinous lines very weak and indistinct. Prosternum and prehensorial feet both almost glabrous, bearing a few long, scattered bristles (Plate **1**, fig. 1).

Anterior prescuta short, becoming long in middle and posterior regions.

Anterior spiracles moderately large, the first considerably longer than the second, broadly elliptic, a few following subsimilar, but nearly all circular, the ultimate ones becoming small.

Ventral pores in a rather large circular to somewhat quadrate or broadly diamond-shaped area on median caudal portion of plate; in front of poriferous area a median sulcus extending toward anterior margin, this crossed a little cephalad of its caudal end by a number of transverse lines.

First pairs of legs shorter and much more slender than the second; anterior legs clearly more robust than the posterior pairs but of about equal length; legs very sparsely hirsute.

Last ventral plate very wide, all margins straight or the caudal a little indented mesially with its lateral portions a little convex, the lateral margins not strongly converging caudad. Coxopleurae moderately enlarged; each with two pits which are usually covered or mostly so by the last ventral plate.

Anal pores concealed.

Anal legs in the male much longer than the penult, crassate, the ultimate articles less so than the proximal; no claw, there being in its place a very small, pilose process resembling a diminutive additional article (Plate 1, fig. 2); in the male sparsely clothed with long bristles and densely with finer short hairs; in the female the legs are also crassate but less strongly so than in the male and they are more uniform in thickness.

Pairs of legs in male 33–59; in female 53–63.

Length of type male 27 mm.; width ad. 9 mm.

Localities.— Chatham, Va.; Landrum, Seneca and Taylor's, S. C.; Hot Springs and Brown's Summit, N. C.; Lexington and Fulton, Ky.; Gainsville, Lula, Tallulah Falls, and Atlanta, Ga.; Anniston, Ala.; Watervalley, Miss.

The specimens described are mainly from Chatham, Va. The specimens from this and several other of the more northerly locations seem to have the number of pairs of legs almost fixed at 53 in both male and female; but in those from other localities, such as Seneca, S. C., the mode is higher although the specimens otherwise agree closely. As previously indicated this species is very close to *bipuncticeps* and the large individuals except upon critical examination are scarcely to be distinguished; this is shown by the fact that they seem always heretofore to have been confused with that species. In many places both *bipuncticeps* and *watsingus* may be secured in the same area; but usually one will be found to prevail to the exclusion of the other. In many places toward the north of our range, *watsingus* seems wholly to replace *bipuncticeps*, while in other large areas the latter alone occurs. In Illinois, Iowa, etc., *watsingus* does not occur, *bipuncticeps*, on the other hand, being there much the commonest geophilid.

CHILENOPHILINAE.

Watophilus, gen. nov.

Frontal suture not evident. Prebasal plate absent. Dorsal plates bisulcate.

Labrum free, tripartite, the middle piece fully separating the lateral and armed along the free edge with a row of small spines or spine-like teeth; the lateral pieces with fewer, larger processes, or spines.

First maxillae with coxae completely fused at middle, separated by suture from distal divisions; palpus biarticulate, the coxa and femur on outer side with very long membranous lappets.

Second maxillae with strongly developed chitinous thickening or pleurosternal suture; palpus triarticulate, the femur produced at distal internal angle and also with smaller processes at distal external angle.

Coxosternum of prehensorial feet without chitinous lines. Prehensorial feet large, much exposed from above, the articles denticulate within. Basal plate trapeziform, strongly narrowed cephalad.

Ventral pores absent.

Last ventral plate wide. Coxopleural pores small, few.

Anal pores present, distinct.

Anal legs unarmed with claws; with seven joints distad of coxopleura, the ultimate very small.

TYPE. *Watophilus alabamae*, sp. nov.

WATOPHILIS ALABAMAE, sp. nov.

Body but little attenuated cephalad, very strongly attenuated caudad of middle.

Caudally yellow, the anterior portion more brownish, fulvous; head and prosternum with prehensorial feet darker, light chestnut; antennae pale brownish, lighter distad.

Head longer than wide in ratio 3:2, nearly; of about equal breadth anteriorly and posteriorly or a little narrower caudad; anterior margin with each lateral portion, straight, the two meeting at median line in a very obtuse angle, the anterolateral angles rounded; sides at middle straight and subparallel, a little converging caudad and cephalad; provided with a few scattered bristles subdefinitely arranged (Plate 1, fig. 7). Basal plate trapeziform, about $\frac{1}{4}$ as long as the cephalic plate, not quite three times wider than long. Prebasal plate not exposed.

Labrum having each lateral piece with but few (mostly about 3 or 4) large spinescent processes from margin; the median piece with about 10 small spines, its free face covered with long seriately arranged bristles. Lappets of first maxillae very long.

Antennae short, somewhat attenuated; articles compactly disposed, all short; the ultimate about equal in length to the two preceding taken together; very sparsely hirsute, the hairs of distal articles becoming more numerous and smaller; mostly but about $1\frac{3}{5}$ as long as the cephalic plate.

Prosternum almost exactly equal in length and breadth; anterior mesial margin substraight, but little excised; chitinous lines absent. First joint of prehensorial feet long, rather narrow, its outer length to the median length of prosternum nearly as 3: 5, length to greater width as 3: 2; claws strongly curved, when closed extending beyond the front margin of head and nearly attaining end of first antennal article; claw at base with a rather long, apically truncate, subcylindrical tooth; the prefemur with two subdentiform but not strongly chitinized processes, one at distal end and one at proximal end of an excavation (Plate **1**, fig. 6).

Dorsum bisulcate as usual, the sulci very fine and also with a fine median sulcus; sparsely hirsute with short straight hairs. Prescuta of middle region moderately long to long, becoming very short cephalad and caudad.

Spiracles all circular, the first much larger than the second, the others decreasing from the second caudad.

First pair of legs distinctly reduced; the posterior pairs clearly more slender than the anterior.

Anterior ventral plates with a median longitudinal sulcus which on the first ones does not extend cephalad of the middle where it ends abruptly but on others reaches cephalic margin and is crossed by transverse depression. Anterior plates with caudal margin extended and fitting into shallow excavation of succeeding one. No ventral pores detected.

Last ventral plate wide; caudal margin straight, the sides converging caudad. Coxopleural pores mostly 4 to 8 of which 2–4 are commonly covered by the ventral plate; when the larger number of pores is present, some may be on lateral portion of coxopleura.

Anal legs much longer and more crassate than penult in both male and female. Without claw, in its place ending in the minute process suggesting an additional article.

Anal pores distinct, moderately large, relatively.

Pairs of legs uniformly 49 in the male, and 51 in the female.

Length of male ad. 14 mm.; of female up to 22 mm.

LOCALITIES.— Anniston and Maplesville, Ala.; Tallulah Falls, Ga.

GNATHOMERIUM Ribaut.

Bull. Soc. hist. nat. Toulouse, 1910, p. 106.

GNATHOMERIUM UMBRATICUM (McNeill).

Mecistocephalus umbraticus McNeill, Proc. U. S. N. M., 1887, **10**, p. 332.

Gnathomerium americanum Ribaut, Bull. Soc. hist. nat. Toulouse, 1910, p. 120.

LOCALITIES.— Watervalley and Grenada, Miss.; ?Maplesville, Ala.; Bremen, Tallulah Falls, Ga.; Landrum, S. C.; Salisbury, Saluda, Hot Springs, Linville Falls, and Catawba, N. C.; Lynchburg, Balcony Falls, and Natural Bridge, Va.; White Sulphur, W. Va.; Fulton and Lexington, Ky.; Altapass, Unaka Springs, Johnson City, and Russellville, Tenn. (also Knoxville, Beaver Creek, and Mossy Creek, Tenn., seq. Bollman).

Among some specimens secured at Russellville there was a female with very recently hatched young about which her body was still coiled.

LINOTENIIAE.

LINOTENIA C. L. Koch.

System der Myriopoden, 1847, p. 86.

The following key will aid in the recognition of the species.

Key to species.

a. Pairs of legs less than 60.
    b. Pairs of legs of male 47–55; of female 49–59. *L. fulva* (Sager).
    bb. Pairs of legs 37–45.
        d. Caudal margin of head angularly extended from sides to median line; basal plate three times as wide as long. *L. chionophila* (Wood).
        dd. Caudal margin of head straight or a little incurved; basal plate but twice or at most 2.5 times as wide as long. *L. branneri* Bollman.
aa. Pairs of legs in male 67–71; in female 71–81. *L. bidens* (Wood).

LINOTENIA FULVA (Sager).

Strigamia fulva Sager, Proc. Acad. nat. sci. Phil., 1856, p. 109.

Strigamia bothriopa Wood, Journ. Acad. nat. sci. Phil., 1862, ser. 2, **5**, p. 46. Trans. Amer. philos. soc., 1865, new ser., **13**, p. 182.

Scolioplanes bothriopus (Wood) Meinert, Proc. Amer. philos. soc., 1886, **23**, p. 222.

Scolioplanes robustus Meinert, Proc. Amer. philos. soc., 1886, **23**, p. 224.

Linotenia robusta (Meinert) Bollman, Entom. Americana, 1888, **4**, p. 4. Bull. 46 U. S. N. M., 1893, p. 76.

Linotenia fulva (Sager) Bollman, Bull. 46 U. S. N. M., 1893, pp. 92, 98, 109, 184.

LOCALITIES.— Gainsville, Bremen, Lula, and Tallulah Falls (also Indian Springs seq. Bollman), Ga.; Landrum and Taylor's, S. C.; Saluda, N. C.; Russellville, Unaka Springs, and Johnson City (also Mossy Creek and Beaver Creek seq. Bollman), Tenn.; Chatham, Natural Bridge, and near Washington, Va.; White Sulphur, W. Va.; Fulton, Ky.

This, the most common Linotenia in the northern states, is also well distributed in the northern part and mountainous sections of the southern states. The southern specimens are larger on the average than northern specimens and show a tendency toward an increased number of legs, males often having as many as 53 and 55 pairs and the females as many as 57 and 59 pairs. At first it seemed that the specimens represented a distinct species; but more careful study of material from many localities shows that intergradation is complete and leaves no satisfactory basis upon which to maintain Meinert's *robusta*, which agrees with these southern specimens. The increased number of legs is a phenomenon met with in various members of this order which have a wide range in proceeding from northern localities to more southern or in going from high altitudes to low. Meinert describes *robusta* as nearly glabrous; but the condition of his type shows this to be due to rubbing. In the antennae of specimens preserved in alcohol there may be considerable variation due in some specimens to differences in the degree of telescoping of the articles, and in some to differences in the recentness of moulting. In the type of *robusta* the articles are well separated so that the shortness of the ultimate article in comparison with the two preceding is exaggerated.

LINOTENIA CHIONOPHILA (Wood).

Strigamia chionophila Wood, Journ. Acad. nat. sci. Phil., 1862, ser. 2, **5**, p. 50. Trans. Amer. philos. soc., 1865, new ser., **13**, p. 189.

Scolioplanes chionophilus (Wood) Meinert, Proc. Amer. philos. soc., 1886, **23**, p. 223.

LOCALITY.— Lexington, Ky.

Ten specimens were secured by the writer at Lexington, Ky., on

August 18, this being the only point for the species thus far recorded within the region covered by the present paper. The species is a boreal one very common in Alaska and neighboring islands and in parts of Canada and is also frequent in the northern sections of the United States. *L. branneri* Bollman seems to replace it in the southern states.

LINOTENIA BRANNERI Bollman.

Ent. Americana, 1888, **4**, p. 4.

?*Scolioplanes chionophila* Brölemann, Ann. Soc. ent. France, 1896, **65**, p. 60.

Rather robust; very strongly attenuated cephalad, less strongly caudad; body and appendages subdensely clothed with rather long stiff hairs.

In alcohol reddish brown or ferruginous, paler caudad and cephalad; head deeper, paler in front of frontal suture; antennae and legs light brown, uniform.

Head relatively wide anteriorly; anterior margin straight in middle, evenly rounded laterally; caudal margin in middle straight or but little excurved, laterally evenly rounded; widest at about junction of middle and caudal thirds; a marked longitudinal median furrow along entire length of head in caudal portion of which there is a short, sharply impressed sulcus; wider than long in about ratio 6:5. Basal plate a little overlapping the caudal margin of the cephalic; a little wider than the head, and very nearly twice as wide as long or a little more.

Antennae moderately long, the articles long or moderately long, gradually decreasing in length from the fifth or sixth to the penult; ultimate article almost exactly equalling in length the two preceding taken together; usually four times, a little more or less, than the head, in the specimen described ad 2.5 mm.

Claws of prehensorial feet when closed attaining the front margin of the head but not at all extending beyond; tooth of claw stout, conical, extending mesocephalad; femora wider than greatest length nearly in ratio 3:2, twice as long as the outer height of the prefemur; caudal margin straight, not at all produced caudad in middle.

Anterior prescuta moderate, about $\frac{1}{3}$ as long as the main scutum of segment, very gradually increasing caudad to the third fourth of length where they are about $\frac{1}{2}$ as long as main scuta, and then again decreasing caudad. Dorsum with a longitudinal median furrow which may be obscure in some parts.

Spiracles all circular and of very nearly the same diameter throughout length of body.

First legs but little reduced, the second of normal size.

Ventral pores in a broad band along caudal border of each anterior plate, the band on more caudal segments dividing into two areas as usual.

Last ventral plate narrow, sides converging caudad; posterior end of plate extended caudad and narrowly rounded. Coxopleurae of segment bearing about 16 pores, large and small, on ventral surface.

Anal legs in female ending in a large claw; about equalling the penult legs in length and thickness. Anal legs in male strongly crassate, thickest at middle of length; subdensely clothed with finer, and moderately long hairs.

Anal pores rather large, usually concealed from ventral side.

Pairs of legs in female 41–43; in males uniformly 41.

Length of female 27 mm.; width ad 1.2 mm. Length of male 22 mm.

LOCALITIES.— Tallulah Falls and Bremen, Ga.; Taylor's, S. C.; Russellville, Tenn.; Brown's Summit, N. C.; Natural Bridge, Va. The type, a female, is from Arkansas.

The female upon which the above description is almost wholly taken is from Tallulah Falls.

var. MIURA, var. nov. Agreeing with typical form excepting in its apparently smaller size, which seems to approximate that of *chionophila,* and especially in the greater shortness of the antennae which likewise are very much in proportion and appearance like those of *chionophila.* The antennae are mostly but three times, a little more or less, as long as the head whereas in the typical form, as above indicated, they are from nearly four to somewhat more than four times as long. While some specimens seem to indicate intergrading, in my material there are evidently two modes of length in the antennae. It seems better, therefore, for the present at least to indicate the two forms.

LOCALITIES.— Fulton, Ky.; Gainsville, Ga.; Saluda, N. C.; Altapass and Russellville, Tenn.

LINOTENIA BIDENS (Wood).

Strigamia bidens Wood, Journn. Acad. nat. sci. Phil., 1862, ser. 2, **5**, p. 47. Trans. Amer. philos. soc., 1865, new ser., **13**, p. 183.

Scolioplanes ruber Bollman, Amer. nat., 1887, **21**, p. 82. Ann. N. Y. acad. sci., 1888, **4**, p. 110. Bull. 46, U. S. N. M., 1893, p. 132.

Scolioplanes bidens (Wood), Brölemann, Ann. Soc. ent. France, 1896, **65**, p. 58, pl. 6, fig. 10–13.

Color in alcohol light brown, the sides and venter paler; head with prosternum and prehensors dark reddish, the frontal region paler; antennae reddish brown, pale distad. In life the color is bright red.

Head widest at caudal end, strongly narrowed from about the caudal fourth cephalad, the sides of the caudal fourth subparallel; caudal margin slightly excurved anterior margin nearly straight between antennae, oblique laterally; a median longitudinal sulcus on caudal portion; wider than long in about ratio 9: 8. Frontal plate not discrete. Prebasal plate not exposed. Basal plate 3.5 times wider than long.

Antennae filiform, not at all attenuated distad; ultimate article clearly shorter than the two preceding taken together; of medium length, in specimen described 2 mm.

Prosternum about 2.3 times wider than median length, 3 times wider than lateral length, the length at side about equalling the outer length of prefemur.

Anterior prescuta moderately short, about $\frac{1}{3}$ as long as main plate, increasing in length caudad and in the posterior region becoming $\frac{1}{2}$, or a little more, the length of main scutum.

Spiracles large, circular, the first larger than the second in the ratio 5: 4, others only very gradually decreasing in size toward the caudal end of the body, those at caudal end smaller than the second and immediately succeeding ones in ratio 4: 3.

First legs reduced, the succeeding several pairs gradually increasing to full size; legs almost glabrous proximally, bearing but scattered and very short hairs, these more abundant on distal joints.

Ventral pores in a moderately wide transverse band along caudal border, this band scarcely indicated on first few sterna, but on most clearly separated into two adjacent areas. Each sternum with a cruciform impression, the longitudinal sulcus being the more deeply impressed and widening at middle of length into a shallow pit; the transverse sulcus often broken into a number of parallel impressions or lines and becoming more deeply impressed on caudal segments.

Last ventral plate narrow, conspicuously narrowed caudad where it runs to an angle; sides nearly straight (Plate **2**, fig. 2). Coxopleurae much enlarged, bearing on ventral surface numerous (ad 24) small pores.

Anal pores present, small.

Anal legs in male strongly crassate; densely clothed with fine, short and straight hairs; ending in a small short claw (Plate **2**, fig. 2).

Pairs of legs (male) 67.

Length 41 mm.; greatest width 1.4 mm.; length antennae 2 mm.

LOCALITIES.— Watervalley, Miss.; Lula, Bremen, and Tallulah Falls, Ga.; Raleigh, Saluda, Linville Falls, and Brown's Summit, N. C.; Altapass, Russellville, and Johnson City (also reported as *L. ruber* from Mossy Creek, and Beaver Creek by Bollman), Tenn.; Lynchburg, Va.; Lexington, Ky.

The description above is of a male from Lexington.

I am unable to find grounds for regarding the specimens here listed as *bidens* as constituting more than one species, although there is considerable variation in some features. By far the majority of females have 71 or 73 pairs of legs; but others have 75, 77, 79 and one has 81 pairs of legs and all without showing any structural differences of importance. The males have mostly either 67 or 69 pairs of legs.

AGATHOTHUS Bollman.

Bull. 46, U. S. N. M., 1893, p. 166.

Frontal plate present. Basal plate wide. Prebasal plate in type species absent. Antennae filiform. Dorsal plates not bisulcate.

Labrum free; tripartite, with the middle piece very large, bowed outward, and fringed with spines along its free margin; lateral pieces with margin smooth or weakly crenate, not armed, overlapped at mesial ends by the middle piece.

Outer process of first maxillae biarticulate, without lappets, apical joint somewhat membranous distad; inner process not separated, coxae not separated by median suture. Coxae of second maxillae completely fused; palpus ending in a small, simple claw.

Prosternum without chitinous lines; anteriorly medianly emarginate. Claw of prehensors wholly unarmed, constricted at base and excavated above, being thin dorso-ventrally at proximal end (Plate **2**, fig. 11).

Ventral pores in a transverse band in front of caudal margin.

Last ventral plate very wide. Coxopleurae with a number of moderately large pores.

Anal pores in type species concealed.

Anal legs composed of six joints, terminating in a claw.

TYPE. *Agathothus gracilis* Bollman.

This genus, the affinities of which have been heretofore wholly problematical, is very close to Linotenia as is evident from the diagnosis above. It seems proper to group these two genera in a distinct subfamily, Linoteniinae, as indicated in the key (p. 410). But one species is known.

AGATHOTHUS GRACILIS (Bollman).

Scolioplanes gracilis Bollman, Ann. N. Y. acad. sci., 1888, **4**, p. 110.

Agathothus gracilis (Bollman) Bollman, Bull. 46, U. S. N. M., 1893, p. 166.

Very gradually attenuated cephalad, more abruptly caudad; sparsely hirsute with short straight hairs.

Yellow; the head with prosternum and prehensorial feet darker, brownish; antennae and legs light yellow.

Head wider than long in ratio 2.2:2; subquadrate; the anterior margin mesally truncate, laterally a little oblique; lateral margin nearly straight over middle part of length, curving mesad at ends; caudal margin very slightly overlapped by the basal plate. Frontal plate discrete. Basal plate nearly 2½ times as wide as long at middle, a little wider than the cephalic plate.

Antennae filiform, the first article wider than others; joints all short excepting the ultimate which is much longer than the two preceding taken together, articles gradually decreasing in length from the second to the penult inclusive; about 3.25 times as long as head; clothed with short hairs which on proximal articles are sparse but become denser distad.

Claws of prehensorial feet very long, when closed nearly attaining the front margin of head, widest above base where they are constricted and also excavated dorsally so as to be thin dorsoventrally and blade-like; all articles lacking denticles; very sparsely hirsute. Anterior median margin of prosternum moderately deeply sinuate; prosternum glabrous or nearly so except laterally; wider than long in ratio 23:13.

Anterior prescuta very short, gradually increasing in length, caudad, becoming moderate or long in middle and posterior regions, where they do not differ much in length.

Spiracles all circular, the first larger than the second, the second and third equal and the ultimate ones but little smaller.

Legs of the first pair but little reduced; anterior and posterior pairs subequal in length and thickness; rather sparsely hirsute.

Ventral pores in a transverse band along caudal border; ventral plates with a median longitudinal sulcus.

Last ventral plate, very wide, cephalic and caudal margins straight, the lateral weakly excurved and strongly converging caudad. Coxopleurae inflated; with a few pores of moderate size or large arranged close to edge of ventral plate and partly covered by it, in the specimen being described in one series, but sometimes in two.

Anal pores present, of moderate size, covered from ventral view.

Anal legs ending in a long claw; in the female proportionately rather slender, but decidedly thicker and longer than the penult pair. Anal legs of male strongly and clavately crassate, its ultimate article abruptly conical, short; densely clothed with fine hairs.

Pairs of legs in female 81; in male 77.

LOCALITIES.— Johnson City (and also Beaver Creek and Mossy Creek seq. Bollman), Tenn.

The description above is chiefly that of a partly grown female. Several other specimens were subsequently found in the collection.

SOGONIDAE, fam. nov.

The two genera for which the present family is established possess in common the following more important characteristics:—

Antennae flattened, conspicuously attenuated distad. Head small or medium in size, leaving the prehensorial feet partly exposed from above.

Mandible without dentate lamellae; with a single pectinate lamella.

Labrum of a single piece apparently, free laterally but fused in middle; free margin as a whole concave, the mesial portion a little convex, fringed with a row of long spines or teeth.

First maxillae with coxae completely fused; inner and outer branches set off by a suture, the outer biarticulate and with membranous lappets.

Second maxillae with coxae completely fused; palpus ending in a simple claw.

Chitinous lines of prosternum strongly developed.

Ventral pores in a narrow transverse band a little caudad of middle of anterior sterna.

Suprascutella absent.

Anal legs five or six jointed; lacking claws.

The two genera as at present known may readily be separated as follows:

Anal legs with five joints distad of coxopleura (a single porigerous pit on each coxopleura.) *Timpina,* gen. nov.

Anal legs with six joints distad of coxopleura; two porigerous pits on each coxopleura. *Sogona,* gen. nov.

SOGONA, gen. nov.

Head rather small. Frontal plate not discrete. Prebasal plate (in type) present. Basal plate wide. Antennae flattened, broad at base and conspicuously attenuated distad. Dorsal plates bisulcate.

Mesial portion of labrum with free margin a little convex, bearing a fringe of long teeth.

Both branches of first maxillae distinctly separated, the biarticulate outer one bearing membranous lappets, in dorsolateral position.

Claw of palps of second maxillae large, simple; sterna completely fused.

Prehensorial feet rather large, partly exposed from above; chitinous lines strongly developed.

Ventral pores in a narrow transverse band immediately behind middle of anterior ventral plates.

Last ventral plate wide. Coxopleural pores opening into two large pits on each side, which are covered by the ventral plate.

Anal legs with six joints, clawless.

TYPE.— *Sogona minima,* sp. nov.

SOGONA MINIMA, sp. nov.

Slender, attenuated cephalad and caudad; body with scattered short hairs, those on legs more numerous but still sparse.

Yellow: head with prosternum and prehensorial feet reddish brown.

Anterior margin of head with lateral margins straight and somewhat oblique, meeting at mesial line in an obtuse angle; sides of head weakly excurved from end to end. Head with but few scattered hairs. Almost exactly equal in length and breadth or a trifle longer than wide; three times as wide as the median length of basal plate. Prebasal plate exposed. Basal plate more than three times wider than the median length.

Antennae moderate or short, the articles decreasing in length distad to the penult; flattened or compressed, attenuated from base distad; ultimate article longer than the two preceding taken together (ad 7: 6); sparsely hirsute at base, the hairs becoming finer and shorter and more dense distad.

Claws of the prehensorial feet when closed not fully attaining the front margin of head; all joints unarmed; prosternum wider than long in the ratio 11: 8; chitinous lines distinctly developed; marked with a distinct median sulcus; anterior median margin only a little angularly depressed mesially; almost glabrous, bearing but a few scattered hairs.

Anterior prescuta very short, others short.

Spiracles round or the first few weakly obliquely subelliptical; the first one clearly larger than the second; first or anterior ones large, decreasing caudad, the posterior ones becoming small.

Each ventral plate with a deep longitudinal median sulcus; anterior sterna angularly extended caudad at middle in a process which fits into a corresponding pit in the succeeding plate. Ventral pores present on anterior plates; few in number and arranged in a narrow transverse band extending across plate between middle and caudal margin, the band widest at median line and running out to a point on each side.

Last ventral plate very wide; sides converging caudad, appearing a little convex; caudal margin straight; sparsely hirsute. Coxopleurae with two large pits on each side, these covered beneath edge of ventral plate.

Anal legs without a claw. In the female thicker and much longer than the penult; sparsely hirsute with long hairs excepting for limited areas on ventral surfaces of joints which are densely clothed with patches of shorter hairs (Plate **3**, fig. 2). Anal legs in male strongly crassate.

Anal pores small, concealed in ventral view.

Pairs of legs in female 53–55; in male 51.

Length of female 16 mm.; of male 12.5 mm.

LOCALITIES.— Taylor's, S. C.; Johnson City, Tenn.

At Johnson City a female, described above, was taken with her young, about which her body was coiled.

TIMPINA, gen. nov.

Prebasal plate in type absent; frontal suture absent. Basal plate wide. Antennae of moderate length; conspicuously flattened; attenuated from base distad; dorsal plates bisulcate.

Labrum apparently of one piece which is free laterally and fused mesially as in the preceding genus; free margin at middle a little convex, fringed with long teeth.

Mandibles with a single pectinate lamella; no dentate lamella.

First maxillae with sterna completely fused; inner and outer branches distinctly set off by suture; the outer biarticulate, with long lappets.

Sterna of second maxillae also completely fused as indicated in description of family; palpus with a simple claw of normal size.

Prehensorial feet conspicuously exposed from above; all articles devoid of teeth; chitinous lines strongly developed.

Ventral pores on anterior sterna, few; in a transverse narrow band caudad of middle of plate.

Last ventral plate very wide. Coxopleurae with a single porigerous pit on each side, this partly covered by ventral plate in type.

Anal legs with but five joints beyond coxopleura; clawless.

TYPE.— *Timpina texana*, sp. nov.

TIMPINA TEXANA, sp. nov.

Conspicuously attenuated caudad and cephalad.

In the type specimen, bleached in the preservative, the body in general appears yellow at ends and darker, more brown, over middle portions; an obscure geminate dark band along part of dorsum.

Head truncate anteriorly and posteriorly, or the anterior margin slightly convex; anterior and posterior margins subequal; sides over middle portion of length nearly straight or a little excurved, at ends bend in mesad; nearly equal in length and breadth or a little longer than wide (39:38); $3\frac{1}{4}$ times longer than the basal plate. Prebasal plate not exposed. Basal plate $3\frac{1}{2}$ times wider than the median length.

Claws of prehensorial feet, which are very short and but little curved, when closed end to end almost exactly even with anterior margin of head; all articles of feet devoid of denticles. Prosternum with anterior median margin weakly incurved; chitinous lines strongly developed; much wider than long (ad 10: 7); $2\frac{1}{3}$ times longer than the prefemur.

Antennae conspicuously flattened and attenuated distad; moderate or short; articles decreasing in length distad to penult; ultimate article of same length as the two preceding taken together or nearly so; proximally clothed with long stiff bristles which distad are replaced by shorter and more densely arranged hairs. Length in type 2+ mm.

Prescutellum relatively very large, several times larger than the spiraculiferous plate, which, in turn, is larger than the postscutellum.

The first and second spiracles vertically elliptical, others round or nearly so; anterior ones large, the first larger than the second, others decreasing in size gradually from the second caudad, the posterior ones very small.

Ventral pores apparently present on only about twelve anterior sterna; few in number and arranged in a narrow transverse band a little caudad of the middle of plate, band tapering to ends, extending across plate entirely on first plates, shorter on more caudal ones.

Last ventral plate very wide, anterior and caudal margins straight; lateral margins convex, converging caudad. Coxopleurae moderate, apparently with a single large porigerous pit on each, covered by edge of ventral plate excepting at ectal edge at which the plate is excised to give free passage from pit.

Anal pores obsolete, being closed or nearly so.

Genital palpi in male short, conical, broad at base.

Anal legs much longer than penult, strongly and uniformly crassate, the fifth or ultimate article clawless, not reduced in diameter.

Length 49 mm.; width 1.4 mm.

LOCALITY.— Austin, Texas. One male collected by Prof. T. H. Montgomery.

While this form has not been found strictly within our limits, it may range into the southern portion, and is discussed here because of its interesting relationship to Sogona.

HIMANTARIIDAE.

GOSIPHILUS Chamberlin.

GOSIPHILUS LATICEPS (Wood).

Strigamia laticeps Wood, Journ. Acad. nat. sci. Phil., 1862, ser. 2, **5**, p. 49. Trans. Amer. philos. soc., 1865, new ser., **13**, p. 186.

Haplophilus laticeps (Wood), Chamberlin, Ann. Ent. soc. America, 1909, **2**, p. 177.

LOCALITIES.— California, Nevada, Texas.

Described originally from Texas. While not actually known from within the district covered by the present paper, its wide distribution across the southern portion of the United States from Texas westward, makes it seem quite likely that it may occur occasionally farther east.

HAPLOPHILUS Verhoeff.

HAPLOPHILUS GRENADAE, sp. nov.

Slender, gradually attenuated cephalad, the caudal portion more abruptly narrowed; entire body and legs clothed sparsely with short straight hairs.

Light brownish yellow, the caudal portion darker, smoky. Head and prehensorial feet with prosternum pale reddish brown; antennae yellow, darkened distad. Cephalic plate much wider than long (a little more than 4:3); sparsely clothed with short straight hairs; rounded, subcircular, excepting the caudal margin which is substraight and overlaps the basal plate. Free portion of basal plate $3\frac{1}{4}$ times as wide as long, the head not fully 2.5 times as long as its median length.

Antennae short, not fully contiguous at base, flattened dorsoventrally and attenuated distad as usual; all articles except the ultimate short, the latter much longer than the two preceding taken together.

Claws of prehensorial feet when closed not attaining front margin of head by a large space; almost glabrous; all joints unarmed; claw stout, moderately curved. Prosternum also almost glabrous; more than twice as wide as long (nearly 2.3:1), not fully twice as long as the prefemur (20:11); anterior margin but weakly sinuate.

Dorsal scuta very obscurely bisulcate. Anterior prescuta short, becoming of moderate length in middle and posterior portions.

Spiracles round, the first not enlarged, all being rather small, and only very gradually reduced caudad.

Ventral plates widely, weakly depressed transversely in line with legs; on posterior of slope of the depression, or partly caudad of it, the ventral pores are arranged in an oblong area which on most plates, especially the more caudal ones, shows a tendency to expand at the ends (Plate **3**, fig. 12).

First pair of legs clearly shorter and more slender than the second; posterior pairs clearly longer and more slender than the anterior pairs.

Last ventral plate with sides strongly converging caudad, substraight or a little incurved, caudal margin straight (Plate **3**, fig. 11). Coxopleurae of last legs inflated, or bearing numerous pores which are closely arranged over ventral surface and in an irregular series along dorsal plate, the dorsolateral surface being free from pores.

Anal legs in female clearly longer than the penult, not crassate (Plate **3**, fig. 11.)

Pairs of legs in the female 67.

Length 26 mm.; greatest width not fully .75 mm.

Locality.— Grenada, Miss.

The type, a single female, was taken July 15.

PLATE 1.

Arenophilus watsingus, gen. et sp. nov. Chatham, Va.

Fig. 1. Ventral view of anterior portion.
Fig. 2. Ventral view of posterior portion.
Fig. 3. Dorsal view of anterior portion.
Fig. 4. Labrum.

Watophilus alabamae, gen. et sp. nov. Anniston, Alabama.

Fig. 5. Ventral view of anterior portion.
Fig. 6. Ventral view of posterior portion.
Fig. 7. Dorsal view of anterior portion.

Linotenia fulva (Sager). Gainsville, Ga.

Fig. 8. Ventral view of posterior portion.
Fig. 9. Ventral view of anterior portion.
Fig. 10. Dorsal view of anterior portion.

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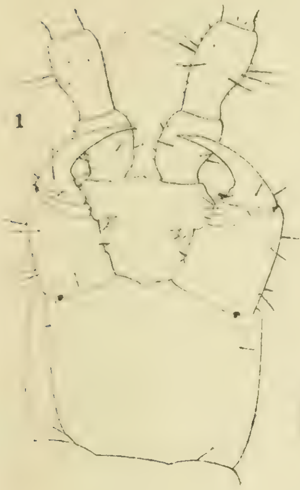

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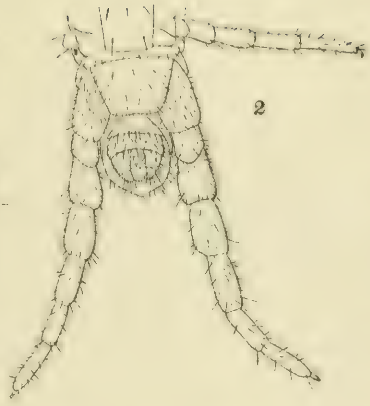

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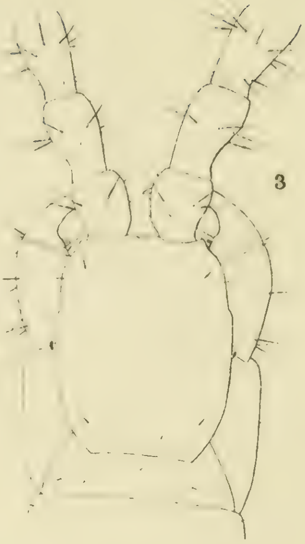

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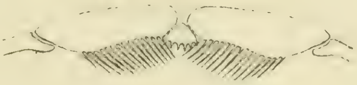

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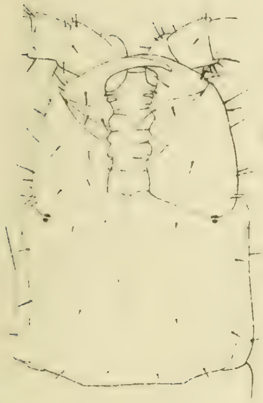

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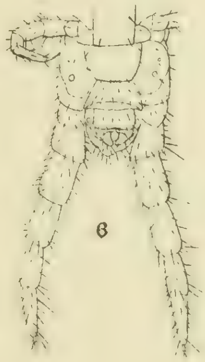

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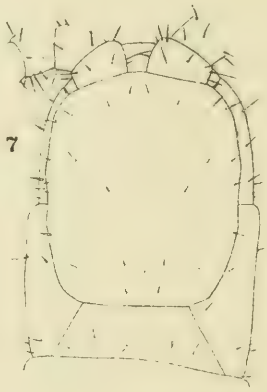

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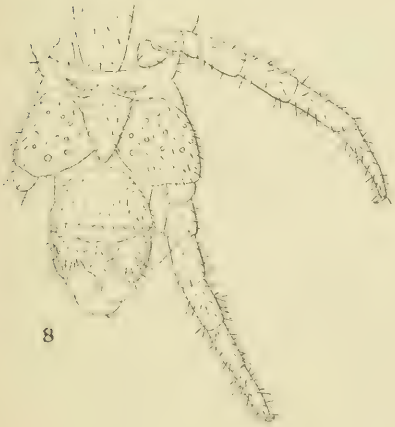

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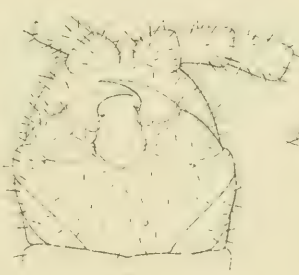

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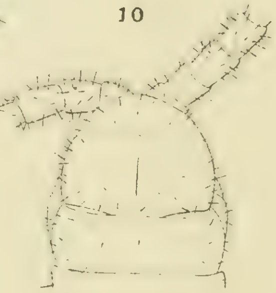


HELIOTYPE CO., BOSTON

PLATE 2.

Linotenia bidens (Wood). Lexington, Ky.

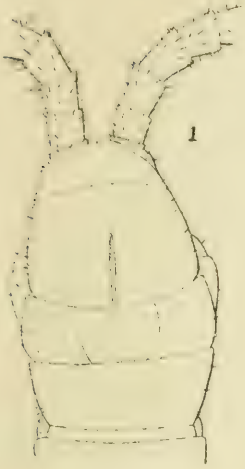
Fig. 1. Dorsal view of anterior portion.
Fig. 2. Ventral view of posterior portion.
Fig. 3. Ventral view of anterior portion.

Linotenia branneri Bollman. Tallulah Falls, Ga.

Fig. 4. Ventral view of anterior portion.
Fig. 5. Dorsal view of anterior portion.
Fig. 6. Ventral view of posterior portion.

Agathothus gracilis Bollman. Johnson City, Tenn.

Fig. 7. First and second maxillae, one side.
Fig. 8. Labrum.
Fig. 9. Ventral view of posterior portion.
Fig. 10. Dorsal view of anterior portion.
Fig. 11. One prehensor with part of prosternum.



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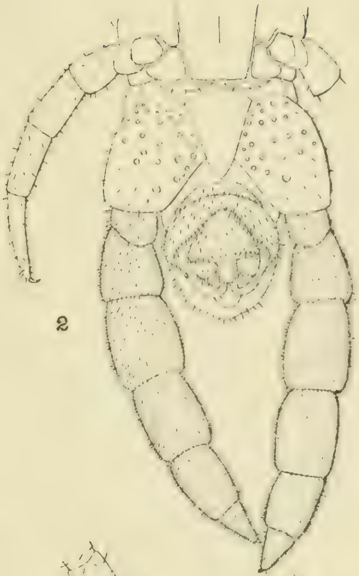

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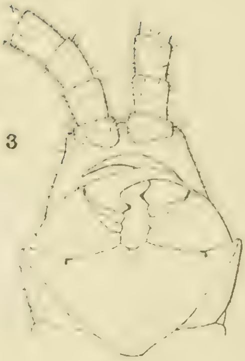

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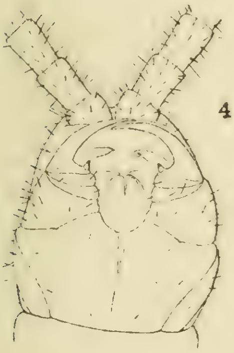

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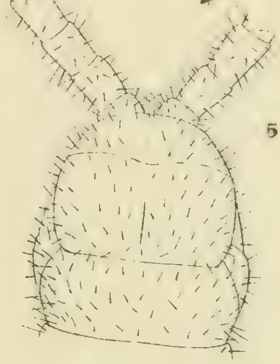

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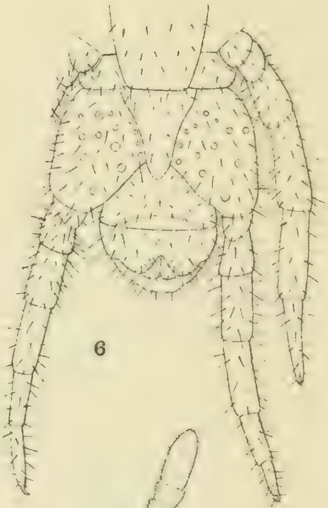

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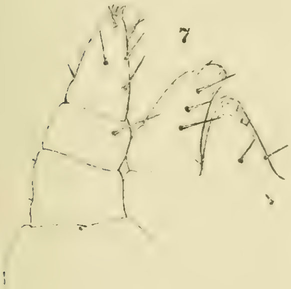

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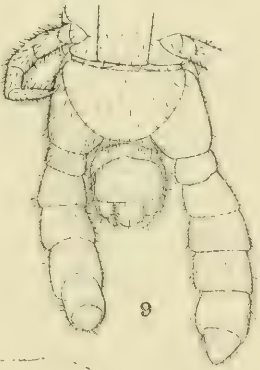

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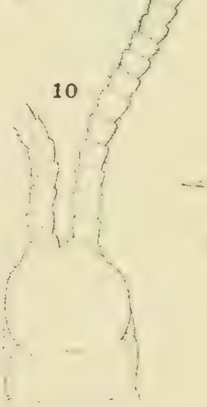

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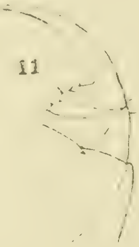

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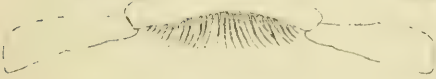

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HELIOTYPE CO., BOSTON

PLATE **3**.

Sogona minima, gen. et sp. nov. Johnson City, Tenn.

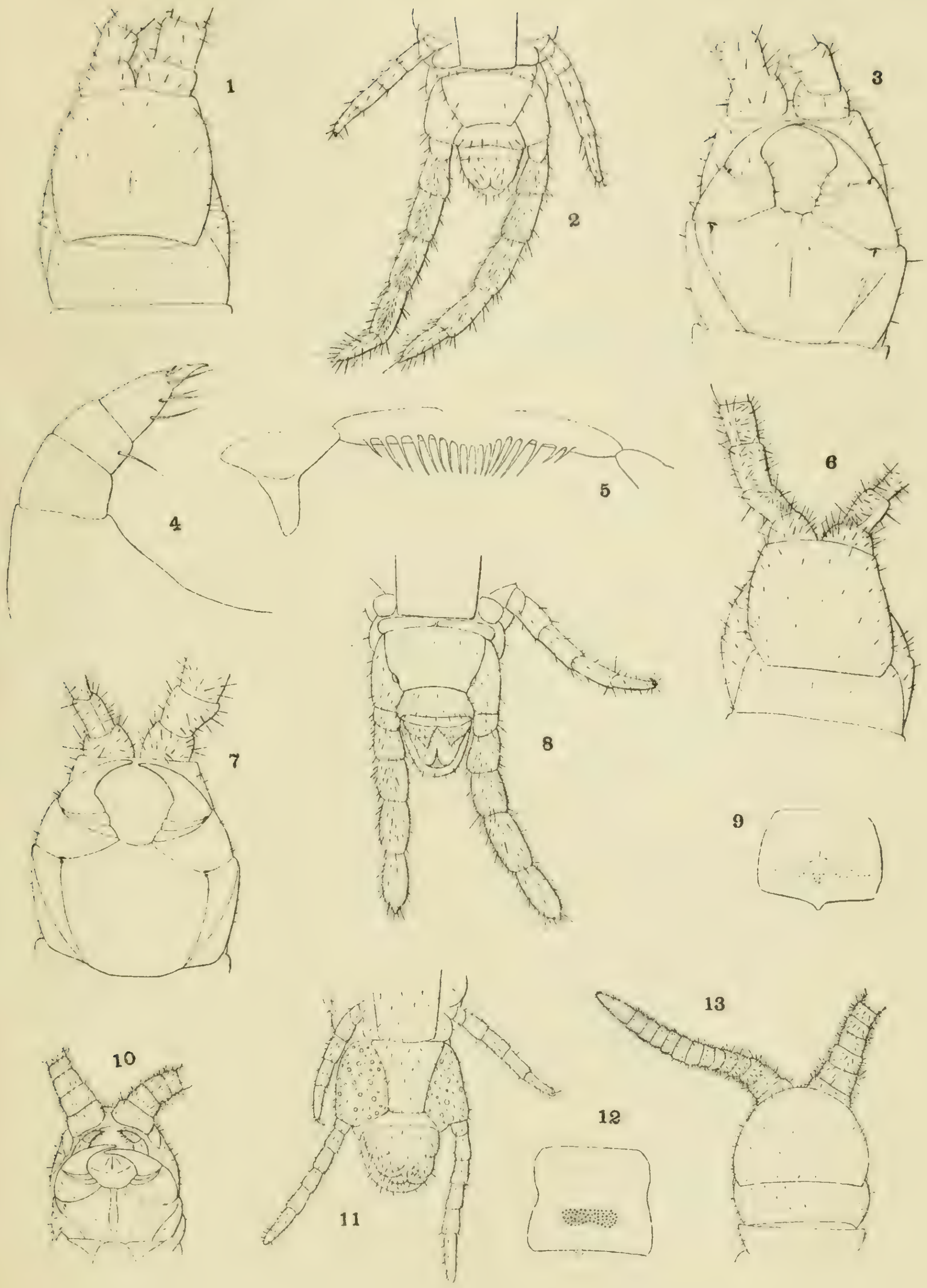
Fig. 1. Dorsal view of anterior portion.
Fig. 2. Ventral view of posterior portion.
Fig. 3. Ventral view of anterior portion.
Fig. 4. Palpus of second maxilla.
Fig. 5. Labrum.
Fig. 9. An anterior ventral plate, showing pores.

Timpina texana, gen. et sp. nov. Austin, Texas.

Fig. 6. Dorsal view of anterior portion.
Fig. 7. Ventral view of anterior portion.
Fig. 8. Ventral view of posterior portion.

Haplophilus grenadae, sp. nov. Grenada, Miss.

Fig. 10. Ventral view of anterior portion.
Fig. 11. Ventral view of posterior portion.
Fig. 12. Tenth ventral plate, showing pores.
Fig. 13. Dorsal view of anterior portion.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HELIOTYPE CO., BOSTON

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
Vol. LIV. No. 14.

NEW AFRICAN RODENTS.

By Glover M. Allen.

CAMBRIDGE, MASS., U. S. A.:
PRINTED FOR THE MUSEUM.
April, 1912.

No. 14.— *New African Rodents.*

By Glover M. Allen.

In a previous paper (Bull. M. C. Z., 1911, **54**, p. 321–331) I have reported on the bats collected in British East Africa during the summer of 1909 by Dr. William Lord Smith, Mr. Gorham Brooks, and myself. In working out the other small mammals obtained by our expedition, several unnamed forms have been found and these, as well as a dormouse from the Cameroon, presented by Dr. Thomas Barbour, are described as new. The new mammals obtained in East Africa are all from the northern Guaso Nyiro, northwest of Mt. Kenia, where as a result of the arid plateau conditions many of the species are represented by local forms of less intense coloration than their relatives of the coastal lowlands. A number of these have already been described by Thomas, Dollman, and others.

The recent intensive study of the small mammals of Africa has shown not only a surprising wealth of species but also an immense amount of local varieties of these, which are the result of response to the greatly diversified physical conditions. This was strongly impressed upon us even in the comparatively short circuit covered to the north and west of Mt. Kenia, and thence to Nairobi and the coast. Dry rocky and bushy country succeeds fertile and well watered lowland, papyrus swamp gives place to broad flat plains, well grassed perhaps, or again, arid and grown up with xerophytic vegetation, according to the character of the soil. Crossing a divide brings one into deep wet forests whose stillness awes even the lightsome Swahili porters into silence, while the higher mountain peaks even under the equator reach an altitude of everlasting snow with alpine meadows below their glaciers. Each variety of country has its characteristic set of inhabitants and these again differ locally.

Among the species here described, the most interesting is perhaps a naked burrowing rodent of the genus Heterocephalus, hitherto unrecorded outside of Abyssinia and Somaliland. It is another of those northeastern types that find their southwestern limits along the Guaso Nyiro. From this locality also, a dormouse (Graphiurus) is apparently for the first time recorded. It seems to be a local race confined to the scanty tree growth which forms a narrow border along the streams. The dark colored, small eared pygmy dormouse from the Cameroon is also of unusual interest.

GRAPHIURUS MICROTIS GRISEUS, subsp. nov.

Type.— Skin and skull, M. C. Z., 8244, adult male, from the northern Guaso Nyiro River, British East Africa; collected 25 July, 1909, by Glover M. Allen. Altitude about 4000 feet.

General Characters.— A medium sized grayish species, apparently nearly allied to *G. raptor* of Mt. Kenia, but much less buffy and with paler feet and belly. From *G. m. saturatus*, described from Mt. Elgon at 9000 feet, it differs in being paler gray above and with dark gray instead of pure white metatarsal area.

Description.— Dorsal surface of head, body, and forearms of a general smoke gray in color, darkest on the mid-dorsal area of the back, due to the predominance of dark hairs; on the sides of the neck and body the color is lighter, nearly a pale wood-brown, produced by the greater admixture of buffy-tipped hairs; the forehead and muzzle between the eyes are nearly clear gray. A blackish patch is present between the anterior corner of the eye and the base of the vibrissae, and a narrow blackish ring encircles each eye. Hands and feet white, except that the tarsal joint and the median portion of the metatarsals are slaty gray. Entire ventral surfaces of the limbs and body, including the throat, and cheeks below the eye are dull whitish, everywhere darkened by the prominent slate bases of the hairs, except at the chin. The tail is as long as the body, flattened and narrow, and approaches a dark fawn color in general tone, slightly lighter below. A few white-tipped hairs form an inconspicuous fringe and tip. Ears large, thinly covered with short brownish hairs. The chest is stained a pale reddish.

Skull.— The skull appears to be about the size of that of *raptor*, but narrower. The bullae are large, and are in contact antero-internally with the hamular processes of the pterygoids. The nasals are broad, their outer borders parallel, not tapering posteriorly, and almost squarely truncate at their proximal end, where they are slightly exceeded in backward extension by the ascending branch of the premaxillary. The dorsal root of the zygomatic portion of the maxillary is slightly in advance of the ventral root.

Measurements.— The type measured in the flesh: head and body, 82 mm.; tail, 79; hind foot (c. u.), 18; ear from meatus, 13.5. A second specimen from the same locality, an adult female, measured: head and body, 91; tail (broken); hind foot, 16.5; ear, 16.

The skull of the type measures: greatest length, 27; basal length, 21.5; palatal length, 10; nasals, 9.7; zygomatic width, 14.8; interorbital constriction, 4.3; width of palate outside premolars, 5.8; upper cheek teeth (alveoli), 3.5; length of bulla, 8.8.

Remarks.— Three specimens of this beautiful dormouse were taken in the arid country along the Guaso Nyiro. One was trapped at the foot of a large hollow tree by the stream, a second among some loose stones at the margin of the river, and the third, an immature example, was caught by the Swahili boys in a tree, by the water's edge, whose dead limbs they were breaking for firewood. Since tree growth, except for the scattered thorn trees, is largely confined to the immediate banks of streams, it follows that this arboreal species is to be found mainly along the waterways.

The adult female referred to is slightly albinistic, with a white spot medially between the ears.

After a careful study of the published descriptions of African dormice, I have been unable to refer these specimens to any species hitherto known. It is perhaps best considered a subspecies of *G. microtis*, but is also apparently allied to *G. raptor* of which I obtained specimens at timber line on Mt. Kenia.

GRAPHIURUS SCHWABI, sp. nov.

Type.— Skin and skull, M. C. Z., 8607, from Kribi, Cameroon, 1911. Collected by Rev. George Schwab and presented by Dr. Thomas Barbour.

General Characters.— A small dark gray species, with the orbital rings scarcely distinguishable from the general dark slaty color of the head. Feet except the distal portion of the toes entirely dusky. Tall white bordered, ears small.

Color.— Pelage loose and full. Entire dorsal surface of the head, neck, body, forearms, and fore and hind feet except the terminal one or two phalanges of the toes a uniform "mouse gray" (Ridgway); a slightly darker, blackish ring is faintly to be distinguished around each eye, but there is no darker patch on the muzzle. The tail is similar but slightly tinged with drab; many of the tail hairs on the dorsal surface are provided with long white points that tend to form a border at the sides and tip. The tail is slightly distichous, with the ventral hairs more flattened than those of the dorsal side. The color of the sides fades into the general smoky gray of the ventral surfaces, which, including the upper lips, and sides of the face below the eye and ear, are whitish. All the hairs of these parts are blackish slate at their bases, with a short whitish tip so that the slate everywhere shows through and darkens the entire under surface of the body and limbs, becoming especially dominant posteriorly.

The ears seem unusually small, but may have shrunken unduly. They are covered with minute appressed hairs visible with a hand lens only. Terminal one or two phalanges of the toes whitish.

Skull.— The skull presents several peculiarities not observed in those of other species examined. The rostrum tapers evenly from the zygomata nearly to a point, as a result of the lateral compression of the tip of the muzzle; the nasals are nearly flat anteriorly, instead of being expanded to form part of the lateral portion of the rostrum; at about half their length they contract and rapidly taper to a blunt point posteriorly, ending about on a level with the back of the first upper molar. The palate terminates in a slight median projection instead of having a smoothly rounded boundary. The upper premolar is very small, with about one half the crown area of the posteriormost molar. Bullae not especially prominent.

Measurements.— The dried skin, well made, measures approximately as follows:— head and body, 74 mm.; tail, 64; hind foot, 18.5; (s. u., 17.8); ear (dry), 7. The skull measures: greatest length, 26; basal length, 20; palatal length, 10; nasals, 10.2; diastema, 6; zygomatic width, 12; mastoid width, 12.9; upper cheek teeth, (alveoli), 3.5.

Remarks.— This very dark dormouse seems most nearly to resemble *G. smithii* from the Victoria Nyansa, Speke's Gulf. It agrees with that species in its uniform dark grayish, but differs in having dark instead of white feet; the tail also as well as the body color seems less dark, judging from Thomas's description. The very small naked ear is also a point in common. Possibly *G. schwabi* is the West African representative of *G. smithii.* The thick full pelage, uniformly dark coloration, even on the feet, and the cranial characters readily mark this well-defined species which I have named after its discoverer, Rev. George Schwab.

THAMNOMYS OCHRACEUS, sp. nov.

Type.— Skin and skull, M. C. Z., 8126, from the Meru River, near the junction with the northern Guaso Nyiro, British East Africa, adult male, collected 8 August, 1909, by Glover M. Allen.

General Characters.— A small pallid form, apparently allied to *T. macmillani* from north of Lake Rudolf, and *T. oblitus* from Voi, but smaller than the former and apparently a much brighter tawny ochraceous and buff instead of "dark olive-buff"; from the latter it differs in paler coloration above, as well as below, where it lacks the distinct tinge of strawcolor; moreover it is a shorter tailed animal.

Description.— Dorsal area from crown to root of tail, tawny ochraceous, brightest on the rump, and slightly darkened in the middle of the back by scattered black hairs; base of the tail clear ochraceous. The muzzle between the eyes, the sides of the face, cheeks, forearms, and sides of the body, grayish washed with buffy and slightly darkened by an admixture of scattered black hairs. A narrow line of clear cream-buff due to the overlapping of the buffy tips of the particolored hairs of the sides, sharply bounds the ventral area, which is pure white to the roots of the hairs including those of the sides of the muzzle nearly to the level of the eyes, the throat, belly, and insides of the legs. The wrists, hands, and feet are clear buffy, the toes white. Ears clothed with short tawny ochraceous hairs. Vibrissae black. Tail scantily covered basally with minute buffy hairs, intermingled above with a few blackish hairs, the latter at length predominating above and below so that the terminal third is dark, nearly Prout's brown; the longest of these hairs do not exceed 3 mm.

Skull.— The skull is small and light, with comparatively short rostrum. There is no incipient postorbital process, but the orbit is bordered dorsally by a line of beading that terminates abruptly about a millimeter anterior to the fronto-parietal suture. The incisive foramina are broad and long, reaching to the level of the first molar. The postero-internal cusp of the first and second molars is undeveloped, but as in the less typical members of the genus, is represented by a ridge extending back to the hinder margin of the third tubercle of the median series. The anterior edge of the zygomatic plate is vertical and straight, and only slightly notched above.

Measurements.— The type measured in the flesh: head and body, 104 mm.; tail, 149; hind foot, 23; ear from meatus, 15. Skull: greatest length, 27.5; basal length, 22.6; palatal length, 13; nasals, 9.2; zygomatic width, 14; interorbital constriction, 4.6; mastoid width, 12; width of palate outside first molar, 5.4; length of incisive foramina, 6; length of molar row (alveoli), 4.5; diastema, 6.8.

Remarks.— This is probably a pallid and slightly smaller race of *T. oblitus* from near the coast at Voi. The darker coloring and longer tail of this coastal species, however, will readily separate it. From *T. macmillani* from the north of Lake Rudolf, it differs equally in less dark color, and slightly smaller size, as well as in lacking the prominent gray shoulder patches. The type and only specimen was trapped among small trees bordering the streamlet known as the Meru River, which here flows through the arid country from Mt. Kenia, to join the Guaso Nyiro.

HETEROCEPHALUS STYGIUS, sp. nov.

Type.— Alcoholic female, adult, with dry skull, M. C. Z., 12470, from Neumann's Boma, on the northern Guaso Nyiro River, British East Africa; collected 6 August, 1909, by Glover M. Allen.

General Characters.— Externally much like *H. glaber* but with a slightly longer tail; nasals more than one third the occipito-nasal length, zygomata evenly bowed out anteriorly, as in *dunni*; coronoid process short, its summit just reaching a line drawn from the tip of the condyle to the point of the incisor. Third upper molariform tooth markedly the smallest.

Description.— General external appearance as in *H. glaber*. Skin dark pigmented but naked except for scattered bristle-like hairs, which are most numerous about the mouth. These are short on the front of the muzzle and increase in length on its sides. The longest are a group of three hairs on the side of the face below and just behind the eye. There are a few short hairs on the back, belly, legs, and tail, and a fringe of stiff short bristles on the margins of the toes except on the outer side of the fifth digit of the pes. All these hairs are unpigmented. On the inner side of each thigh is a small glandular patch. The ear conch is vestigial but projects about a millimeter from the side of the head.

Skull.— The skull is similar to that of *H. glaber* as figured (× 2) by Thomas (Proc. Zool. soc. London, 1885, pl. 54, fig. 5) except that the nasals are longer in proportion exceeding one third of the occipito-nasal length of the skull, and the zygomata are more evenly bowed out in their anterior portion, thus approaching *H. dunni.* The sagittal crest is well marked and extends forward from the occipital ridge for about one half the length of the braincase whence the supraorbital ridges diverge to the anterior corner of each orbit.

The teeth appear to differ slightly in their conformation from those of *H. glaber,* if the description and figures of Parona and Cattaneo (Ann. Mus. civ. Genova, **33**, pl. 13, figs. 7, 8) are accurate. All the upper molariform teeth are figured as of essentially the same size in *H. glaber* though described as diminishing slightly from the anterior to the posterior end of the series, and as having a single external enamel fold each (Thomas, 1885). In *H. stygius,* however, the last (or third) upper molar is much the smallest, rounded in outline, and of about one half the crown area of the tooth next anterior. The first and second molariform teeth are subequal, the former with a well defined sulcus on the inner side opposite the external fold, marking a slight infolding of the enamel. Of the inferior molariform teeth, the second is the largest; the first and third are of nearly equal length antero-posteriorly, but the former is much the narrower. Each has an external and an internal enamel fold forming thus a rather flattened figure 8 pattern. Parona and Cattaneo show but one sulcus on the external side of the first tooth in *H. glaber* but their figure is probably incorrect as Thomas states that each has an external and an internal fold.

The coronoid process of the mandible is short as in *H. dunni* and *Fornaria phillipsi,* and just reaches a line joining the condyle with the point of the incisor. The incisive foramina are anterior to the maxillary bone and their posterior end just reaches the premaxillo-maxillary suture.

Measurements.— The type was measured when collected, as follows (measurements of *H. glaber* are added in parentheses): head and body, 98 mm. (95); tail, 47, (39); hind foot, 22 (21.2).

The skull: occipito-nasal length, 21 (21.5); nasals, 8.3 (7.8); basal length, 20 (21.5); palatal length, 12.6 (13.6); zygomatic width, 17.8 (18.3); mastoid width, 12.5 (12); interorbital constriction, 6 (6); mandible from condyle to anterior base of incisor, 16.7; upper cheek teeth (alveoli), 3.4; lower cheek teeth (alveoli), 3.

Remarks.— The single specimen on which this species is based was taken at our camp near Neumann's Boma on the (northern) Guaso Nyiro River, near its northernmost bend. It was captured alive by one of our Swahili boys who found it running about near the camp fire at night. He said that at first it had come near where he was sitting, but he paid no attention until shortly it returned, and he caught it. I have found no mention of such above-ground activity on the part of this animal. When handled it gave vent to its displeasure in a few soft coughs, but did not attempt to bite. This interesting specimen is the first of its genus to be recorded south of Somaliland, and the known range is thus considerably extended to the south and west. The soil along the river valley where it was captured, is light and sandy, and suitable for burrowing. The elevation at this point is probably 3000 to 4000 feet, practically at the upper limit of growth of the ivory-nut palms. No other sign of its presence was discovered, so that it is probably local or uncommon here. It is another example of the arid-country Abyssinian and Somaliland types whose range extends southward to the Guaso Nyiro region.

Of *Heterocephalus glaber* specimens are recorded from Shoa, southern Abyssinia, the type locality (Rüppell); Gerlogobie, Ogardain, in Somaliland (Thomas); the Errer (or Harar) region, of Italian Somaliland and from Milmil (Rhoads).

In its rounded zygomata and low coronoid process, this species differs from *H. glaber* and resembles *H. dunni* and *Fornaria phillipsi*, but from both these last it is at once distinguished by its larger molariform teeth, its size and proportions. Intergradation with *H. glaber* may be expected when specimens are obtained from intermediate localities.

TATERILLUS MELANOPS, sp. nov.

Type.— Skin and skull, M. C. Z., 8132, male, from the arid plains by the Meru River, a branch of the northern Guaso Nyiro, British East Africa, collected 11 August, 1909, by Glover M. Allen.

General Characters.— A medium sized species, probably related to *T. osgoodi* of the coastal lowlands (type from Voi), but paler above, and with the black facial marking restricted to a narrow ring about the eye and an elongate spot behind it, and below the ear.

Description.— Dorsal area, including a narrow line from the muzzle, between the eyes, the entire crown, nape, and back, ochraceous buff darkened by the uniform admixture of fine black tips to the hairs; the color is slightly warmer on the rump where the pale terminal ring of the hairs becomes nearly ochraceous. Sides of the muzzle, including a narrow stripe up over each eye, sides of neck and body, and the thighs, nearly clear ochraceous buff with a few scattering hairs entirely black. The hairs of the dorsal area have long slaty bases with short terminal ochraceous buff rings, while those of the flanks are slightly paler with much longer (4 mm.) ochraceous buff tips which fade basally to whitish. On the sides of the muzzle, however, and along the lateral border of the body, the bases of the buff hairs are wholly pure white. A whitish spot is present above the eye, extending to the base of the ear, and another at the posterior base of the ear. A narrow black ring surrounds the eye and is continued posteriorly as an elongate black patch below the ear. Hands and feet white above, with a line of buffy on metacarpals and metatarsals. Ears scantily clothed with minute pale hairs and obscurely edged with blackish. Proximal third of the tail like the back, scarcely paler below; terminal half or two thirds above and below clad with dark hairs, nearly seal-brown, which lengthen progressively toward the tip, especially above, forming a terminal tuft, whose longest hairs measure about 15 mm. Ventral surfaces of body and limbs pure white to the roots of the hairs except about the ankles where is a ring of hairs seal-brown to their bases.

Skull.— The posterior palatal foramina extend, as in other members of this genus, from the level of the front of the first molar to the middle of the second. The upper incisors have a distinct groove slightly external to the center. The nasals are exceeded by the posterior prolongations of the premaxillaries and are squarely truncate proximally instead of tapering to a median point.

Measurements.— The type measured in the flesh: head and body 122 mm.; tail, 165; hind foot (c. u.), 33; ear from meatus, 18. The skull measures: greatest length, 36.2; basilar length, 26.5; zygomatic breadth, 18; nasals, 14; interorbital constriction, 7; mastoid breadth, 16.5; diastema, 9; upper molar series, 5; audital bullae, 10 by 5.5.

Remarks.— This is a pale form from the arid plateau to the north and west of Mt. Kenia, bordering the Guaso Nyiro. It seems related to the rufous *T. osgoodi* of the coast or perhaps to *T. tenebricus* but differs in size, color, and the character of the black markings of the head from all of these. It seems to represent a distinct species from *T. nubilus illustris,* also found in the Guaso Nyiro region, which in addition to smaller size, differs notably in having practically no black cheek-patch.

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
Vol. LIV. No. 15.

SOME CUBAN CRUSTACEA.

By Mary J. Rathbun.

WITH NOTES ON THE ASTACIDAE, By Walter Faxon, and
A LIST OF ISOPODA, By Harriet Richardson.

With Five Plates.

CAMBRIDGE, MASS., U. S. A.:
PRINTED FOR THE MUSEUM.
October, 1912.

No. 15.— *Some Cuban Crustacea.*

By Mary J. Rathbun.

With notes on the Astacidae, by Walter Faxon, *and a list of Isopoda*, by Harriet Richardson.

During a trip to western Cuba last February and March, Dr. Thomas Barbour obtained several species of Crustacea, including two new shrimps living in caves. These are not only very distinct from any previously recorded, but represent two widely different families. One is a Palaemonetes, (Palaemonidae), living in fresh water and blind like the two cave-dwelling species of the genus already known;[1] the other is one of the Hippolytidae, found in slightly brackish water, and having well-developed ocular pigment. No member of this family has heretofore been found in caves, or to my knowledge, in brackish water.

PALAEMONIDAE.

Palaemonetes calcis, sp. nov.

Plate **1**, figs. 1–5.

Type.— M. C. Z., 7,415. Cuba: Pool in a cave between Madruga and Aguacate. Thomas Barbour.

Body stout; carapace as long as the last 4 segments of the abdomen, high and thick; the median carina begins at the cervical suture, is subacute, and bears a single sharp spine a little behind the line of the orbits; the rostrum is about $\frac{2}{5}$ as long as the remainder of the carapace, inclined slightly downward, upper and lower edges thin, unarmed, gradually converging to an acuminate tip, a few scattered hairs on upper margin; a spine on the anterior margin of the carapace above the base of the antenna.

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[1] *Palaemonetes antrorum* Benedict, Proc. U. S. nat. mus., Apr. 14, 1896, **18**, p. 615; from artesian well 188 feet deep, San Marcos, Texas.

Palaemonetes eigenmanni Hay, Proc. U. S. nat. mus., Feb. 2, 1903, **26**, p. 431, text fig. 2; from cavern at Ashton, Cuba.

Eyes short, stout, subconical, with the end of the cone rounded, and an acute tubercle on the outer side of the summit; eyes without pigment.

Antennules more than $1\frac{1}{2}$ times as long as the body; peduncle very slightly longer than the rostrum; first segment as broad as long, antero-external spine broad, reaching past the middle of the second segment; second segment broader than long; third segment about as broad as long.

Antennae about $2\frac{1}{4}$ times as long as the body, the peduncle falling short of the end of the first segment of the antennules; the first segment of the antennae bears a sharp spine on its anterior margin just below the outer angle; scale broad, subovate, reaching a little beyond the antennular peduncle, and armed with a small spine near its outer extremity.

The incisor process of the mandible has a bidentate tip, the molar process has the extremity partially dentate (Plate 1, fig. 4).

The outer maxillipeds if extended would reach beyond the antennal scale by the length of the last segment.

First pair of pereiopods slender, reaching beyond the scale by the length of the propodus and half the carpus; ischium expanded below except at proximal end; merus and carpus subequal, carpus a little the longer, widening distally; palm slightly dilated, exceeding the carpus in width somewhat; fingers $1\frac{1}{2}$ times as long as palm, tapering only near the tip.

Second pair of pereiopods as long as the body; ischium no wider than merus and $\frac{2}{3}$ as long; carpus a little longer than merus and widening from the proximal to the distal end; palm much swollen; fingers slender and of even width to near the tips, $1\frac{1}{2}$ times as long as palm, scarcely longer than carpus, prehensile edges thin, corneous, translucent, unarmed except near the base, where the dactylus bears a shallow lobe followed by a small tooth, both of which fit closely against a complementary tooth on the fixed finger; tips corneous, crossing well past each other.

Third, fourth, and fifth pairs of pereiopods subequal, long and slender, the fifth pair reaching beyond the scale by the length of the dactylus and one half the propodus.

Postero-lateral angle of fourth segment of abdomen almost a right angle; of fifth and sixth segments acute; sixth segment slightly longer than broad; telson $1\frac{1}{2}$ times length of preceding segment, dorsal surface flattened, forming an angle with the lateral surfaces, two dorsal spines on each side near together, just posterior to the middle, posterior margin broadly rounded, armed with 4 pairs of spines, of which the 3 inner pairs are subequal in length, the first and second pairs very weak, the third pair much the strongest, the outer pair very small; both branches of swimming-fan broad, suboval, the outer exceeding the inner branch, as much as the inner does the telson; tooth of outer branch broadly triangular, tipped with a small spine.

Dimensions.— Type ♀, total length 36.8 mm. (approx.). Length of carapace 14.8 mm., of abdomen 22 mm. (approx.).

Color.— Whitish.

Dr. Barbour says of this species:—

"These shrimps were collected from a pool at the bottom of a deep, steeply sloping, limestone cave, situated directly beside the calzada which runs from Madruga to Aguacate, just about a kilometer beyond where this calzada branches off from the one from Madruga to Matanzas. They were found in company with the blind isopod, *Cirolana cubensis* Hay. The shrimps were quite abundant and were usually seen swimming slowly about in the water at some distance from the bottom. I caught several individuals on the first trip, but the bottle got broken and I had to return for more. On the second visit I found them much more abundant and obtained the whole lot by wading or swimming about in the water holding a small electric light and dip net. Finally the water became so stirred up that it was impossible to see anything. I saw no blind fish in this cave. I had kindly helping me on this trip Dr. J. L. Bremer and Mr. Elliot C. Bacon."

This species is very distinct from the other cave-dwelling Palaemonetes. It approaches nearest to *P. eigenmanni* Hay which has similar eyes but a more slender body, much longer rostrum, armed above with a series of teeth, and more slender chelae.

PALAEMONETES EIGENMANNI Hay.

Palaemonetes eigenmanni Hay, Proc. U. S. nat. mus., Feb. 2, 1903, **26**, p. 431–433, fig. 2.

Type locality:— Cave at Ashton, southwest of Alquizar, Province of Habana.

Cave near Güira de Melena, Habana Province; Dr. Pedro Perdigon, collector; presented by Dr. Carlos de la Torre; 4 specimens. M. C. Z., 7,427.

The largest specimen that Mr. Hay described was 23 mm. long.

The largest from this locality is 32 mm. (tip of rostrum broken off). The rostrum reaches either just to the end of the scale or a little beyond it; the superior teeth vary from 6 to 9, 3 of which are on the carapace proper or behind the line of the orbits.

The outer of the two long flagella of the antennules is as long as the flagellum of the antennae, or about twice as long as the body.

The postero-lateral angle of the fifth and sixth segments of the abdomen is subacute.

Palaemonetes cubensis Hay.

Palaemonetes cubensis Hay, Proc. U. S. nat. mus., Feb. 2, 1903, **26,** p. 433.

Arroyo de la Cruz, Province of Pinar del Rio. One specimen collected by Dr. Rafael del Pino, May 4, 1912, presented by Dr. Carlos de la Torre. M. C. Z., 7,442.

Laguna Las Cañas, Marti, Province of Matanzas. Two specimens collected by Dr. Rafael Gómez Guardiola, April 25, 1912, presented by Dr. Carlos de la Torre. M. C. Z., 7,447.

Macrobrachium olfersii (Wiegmann).

Palaemon olfersii Wiegmann, Arch. f. naturgesch., 1836, **2**, **1**, p. 150.

Near Guaos, Jurisdicion de Cienfuegos. M. C. Z., 7,421. One specimen was infested with an isopod parasite (*Probopyrus panamensis* Richardson) in its left branchial cavity.

HIPPOLYTIDAE.

The genera of this family are usually characterized by the presence or absence of a cutting edge and a palp on the mandible, and the number of segments (varying from 2 to "many") into which the carpus or wrist-joint of the second pair of pereiopoda is divided.

The new form described below resembles Latreutes Stimpson,[1] Platybema Bate,[2] and Nauticaris Bate,[3] in lacking a cutting edge on the mandible, while differing from them in the large number of carpal segments of the second foot. In this respect it resembles certain genera established by Bate, viz. Chorismus,[4] Merhippolyte,[5] and Amphiplectus,[6] all of which, however, have a cutting edge on the mandible.

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[1] Proc. Acad. nat. sci. Phila., 1860, p. 27 [96].

[2] Challenger rept. Zool., 1888, **24**, part 52, p. 578.

[3] *Op. cit.*, p. 602.

[4] *Op. cit.*, p. 616.

[5] *Op. cit.*, p. 618.

[6] *Op. cit.*, p. 622.

BARBOURIA, gen. nov.

Body stout; rostrum small, compressed laterally.

Antennulae and antenna very long.

Antennular scale vertically placed.

Mandibles with a 3-jointed palp, and no cutting edge.

First maxilla (or maxillula) with two endites.

Second maxillipeds composed of 6 segments.

Outer maxilliped provided with an exopod and epipod; first, second, third and fourth pereiopods with epipods.

Carpus of second pereiopods many-jointed.

Type species, *Barbouria poeyi*, sp. nov.

BARBOURIA POEYI, sp. nov.

Plates **2–5**, figs. 6–22.

Type.— M. C. Z., 7,418. Cave near seashore, between Morro Castle and Cojimar; March 10, 1912. Thomas Barbour.

Thorax stouter than abdomen; carapace strongly arched both in side and front views; median carina prominent except posteriorly where it fades out gradually toward the posterior margin; the downward slope of the anterior half is continued by the upper margin of the rostrum, although the latter may be a little more horizontal; a row of from 4 to 6 spines begins at the anterior third of the carina and is continued on the rostrum; usually 3, sometimes 2, of these spines are on the carapace proper; rostrum short, reaching to middle, or nearly to middle, of second segment of antennules, acutely pointed, armed below with from 2 to 4 small spines. Two slender spines near anterior margin of carapace, one on the suborbital lobe, the other behind the antenna.

Eyestalks short and stout, subconical, terminating in large, dark blue corneae.

Antennular peduncle stout, less than half as long as carapace, excluding rostrum; first segment twice as long as wide, its external scale turned almost vertically; scale suboval, shorter than the segment itself, base thickened, outer surface concave, having a broad longitudinal furrow, upper margin armed near its extremity with a small spine; second segment shorter than first; third $\frac{2}{3}$ as long as second; flagella about $1\frac{1}{4}$ times as long as body.

Antennal peduncle reaching to the end of first segment of antennular peduncle; scale extending considerably beyond antennular peduncle, narrowing toward tip, two longitudinal grooves above, a small tooth at end of outer margin which overreaches blade of scale; flagellum more than twice as long as body.

Mandible with a stout molar process and a 3-jointed palp; the corneous extremity of the molar process has a crenulated edge on one side; the first and second segments of palp are of subequal length, the third segment is about twice as long as the second, and has a fringe of long bristles attached at and near the tip.

The outer maxillipeds are stoutish and surpass the antennal scale by $\frac{1}{3}$ the length of the terminal segment; this segment is subsquamose, being covered with deep pits from which arise fine setae.

The first pair of pereiopods are shorter than the maxillipeds and reach beyond their penultimate segment only by the length of the fingers; the carpus widens considerably from the proximal to the distal end; propodus nearly as long as carpus; palm swollen; fingers $\frac{2}{3}$ as long as palm, meeting throughout, tips corneous.

Second pair of pereiopods filiform, very long, reaching beyond the antennal scale by the length of the propodus and carpus and nearly half the length of the merus; the carpal segments vary from 26 to 32; the merus also is faintly subdivided into segments varying from 12 to 17.

Third, fourth, and fifth pairs of feet filiform, similar, the merus of the third pair reaching a little past the middle of the scale, of the fifth pair to the base of the scale; the third and fourth pairs are similar in length, the propodus of the fifth pair is greatly elongated, being $1\frac{1}{2}$ times as long as that of the fourth pair; dactyli short and stout, tipped with a corneous spine which is nearly half as long as the remainder of the segment; 2 more slender corneous spines on the lower margin.

The abdomen in its highest part is only about $\frac{2}{3}$ the height of the carapace; postero-lateral angles of third and fourth segments rounded, of fifth and sixth segments armed with a short spine; length of telson $1\frac{1}{6}$ times the sixth segment; the distance between the 2 pairs of dorsal spinules is equal to the distance between the posterior pair and the extremity; the terminal spines consist of a pair situated at the outer angles, and longer than the posterior width of the segment, a pair of short ones originating above and overlapping the long pair, and a submedian pair of intermediate length originating at a lower level than the others. The inner branch of the swimming fan is narrow-oval, and reaches just to the end of the telson, exclusive of spines; the outer branch is much larger, reaches nearly to the end of the longest spines on the telson; it bears a slender, movable spine near the end of its outer margin.

Dimensions.— Type ♀, total length of body 42 mm., length of carapace 14.5 mm., of abdomen 26 mm. (approx.)

Dr. Barbour's notes on this species are quoted in full:—

"This is how we came to get the new red shrimps. Sitting with Dr. Carlos de la Torre at his house one afternoon looking over some manuscript notes of Poey's, which he is editing, we came across a bare statement on a sheet of paper in Poey's portfolio that in a cave between Morro Castle and Cojimar there were shrimps which the country people said were already cooked, they looked so red. We became quite interested over this note and Torre suggested at once that we get a boat and go over to Morro Castle where Poey's old fisherman-collector lived. It was quite dark and we had some difficulty finding a boat along the waterfront, but finally secured one, rowed over and found the man, who said that he remembered distinctly where the cave was, and that he himself had told Poey of the existence of these shrimps. He promised to go with us the next morning. Bright and early the following day Dr. J. L. Bremer, Dr. de la Torre, and myself all returned to the Morro where we met our fisherman friend with a motley following. A long, hot walk through the scrub brought us to two sink holes, some distance apart, evidently places where the roof of two low caves had partly fallen in, permitting one to look down a great depth into a very deep cavern, almost full of clear, slightly brackish water, which we were told, fluctuated slightly with each tide. In both of these caves the red shrimps were very abundant and in one of them a blind fish, probably Stygicola, was also seen. In life they were a beautiful, translucent, crimson color, while the long antennae and the first pair of chelate appendages were pure white, contrasting strongly with the color of the body of the animal and the other legs. We brought a number of these back to Havana alive as well as a supply of water from the cave. We had hoped that it might be possible to bring some north with us alive, but in this we were entirely unsuccessful."

POTAMONIDAE.

Epilobocera cubensis Stimpson.

Epilobocera cubensis Stimp., Ann. Lyc. nat. hist. N. Y., 1860, **7**, p. 234.

San Diego de los Baños. M. C. Z., 7,413.

EPILOBOCERA ARMATA Smith.

Epilobocera armata Smith, Trans. Conn. acad. arts & sci., 1870, **2**, p. 151, pl. 5, fig. 2.

Near Guaos, Jurisdicion de Cienfuegos; young specimens. M. C. Z., 7,414.
Not previously recorded from western Cuba.

ASTACIDAE.

By WALTER FAXON.

CAMBARUS CUBENSIS Erichson.

Astacus (*Cambarus*) *cubensis* Erichs., Arch. f. naturgesch., 1846, **12**, 1, p. 100.

Eight specimens (3 ♂, 5 ♀), M. C. Z., 7,407, were collected by Dr. Barbour in the Botanic Garden of the Institute, Principe, Habana.

CAMBARUS CUBENSIS CONSOBRINUS (Saussure).

Cambarus consobrinus Sauss., Rev. et mag. de zool., 1857, ser. 2, **9**, p. 101. Mem. Soc. phys. hist. nat. Genève, 1858, **14**, p. 457, pl. 3, fig. 21.

Nine specimens (5 ♂, 4 ♀), M. C. Z., 7,343, were secured by Dr. Barbour at San Antonio de los Baños, in the interior of the Province of Habana. They were got from boys who were using them for fish-bait. These specimens differ from the true *C. cubensis* Erichs. in the following regards:— the rostrum is narrower, more deeply concave above; its margins more elevated and less convergent between the base and the pair of lateral spines near the distal end; these lateral spines, moreover, are much better developed than they are in *C. cubensis,* and the rostral acumen is longer; the post-orbital ridge is more prominent, distinctly grooved along its outer face, and terminates anteriorly in an acute spine much more strongly emphasized than in the typical *C. cubensis;* there is, too, an evident lateral spine on each side of the carapace, on the hind border of the cervical groove,— a spine which is not present in typical specimens of *C. cubensis.* The external sexual organs are alike in the typical form and the form *consobrinus.*

Cotypes of Saussure's *Cambarus consobrinus* are now dispersed in the Museums of Geneva, Paris, Berlin, and Washington. Belike Saussure's material embraced some of the typical form of *C. cubensis*, though his description and figures were based on the form with long rostral acumen, and distinct rostral and lateral thoracic spines; the type locality of *consobrinus*, moreover, is the *central part* of the island.

In the cotype in the U. S. national museum (No. 20,684), a male dried and transfixed with a pin, the rostrum is abnormal, the right margin being pared away toward the tip, carrying with it the right marginal spine. This deformity was evidently present in the living specimen. On the left side the marginal rostral tooth or spine is well developed, as are also the thorns at the front end of the post-ocular ridges. The lateral thoracic spines are also fairly well marked.

CAMBARUS CUBENSIS RIVALIS, subsp. nov.

This form is a denizen of the mountain streams of western Cuba. The extent of its distribution remains to be determined by further exploration of the island. The type specimens (M. C. Z., 7,406), two males of the second form and three females, were captured by Dr. Barbour in a mountain stream near San Diego de los Baños, in the Province of Pinar del Rio. There are also specimens in the U. S. national museum from the same place (28,626, 28,627) and from a mountain brook north of the town of Pinar del Rio (23,656, 23,657).

It differs from the typical form of *C. cubensis* (which lives in the low country on the coast of Cuba) in having a much shorter and broader areola, a shorter, broader, and more heavily granulated chela; the sides of the rostrum, too, are more nearly parallel and bear a pair of distinct lateral spines at the base of the acumen. In so far as the rostrum is concerned it resembles *C. c. consobrinus*, but it differs from that form by its short and wide areola and absence of lateral thoracic spines.

The sexual parts are like those of *C. cubensis*.

Length of an ovigerous female, 44 mm., length of carapace, 21 mm., length of areola, 6 mm., breadth of areola, 2 mm.

ISOPODA.

Determined by Harriet Richardson.

CIROLANIDAE.

CIROLANA CUBENSIS Hay.

Cirolana cubensis Hay, Proc. U. S. nat. mus., Feb. 2, 1903, **26**, p. 430.

Two specimens (M. C. Z., 7,423) from a cave between Madruga and Aguacate, Province of Habana (Dr. Barbour).

BOPYRIDIDAE.

PROBOPYRUS PANAMENSIS Richardson.

Probopyrus panamensis Rich., Proc. U. S. nat. mus., Aug. 29, 1912, **42**, p. 523.

One specimen (M. C. Z., 7,424) from near Guaos, Province of Santa Clara, on *Macrobrachium olfersii* (Dr. Barbour).

ARMADILLIDIDAE.

CUBARIS MURINA Brandt.

Cubaris murina Brandt, Bull. Soc. imp. Moscou, 1838, **6**, p. 28.

Two specimens (M. C. Z., 7,422) from near Guaos (Dr. Barbour).

PLATE 1.

Fig. 1. Palaemonetes calcis, side view, × 2.
Fig. 2. “ “ tail-fan, dorsal view, × 8.
Fig. 3. “ “ antennal scale, ventral view, × 8
Fig. 4. “ “ mandible, × 20.
Fig. 5. “ “ chela of first pair, × 8.

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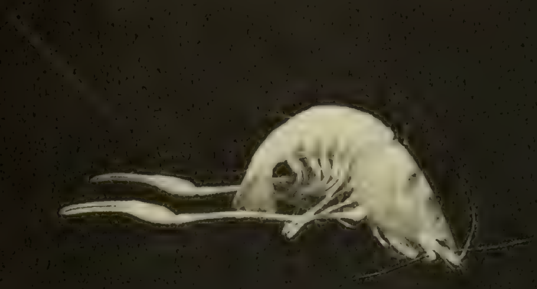

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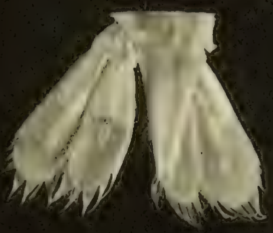

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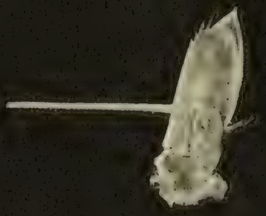

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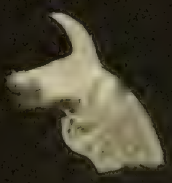

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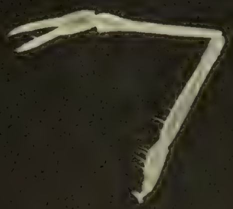
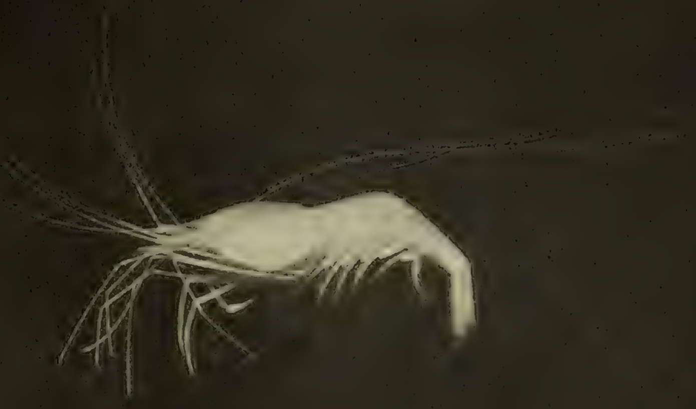


HELIOTYPE CO. BOSTON

PLATE 2.

Fig. 6. Barbouria poeyi, side view, × 2.
Fig. 7. " " dorsal view, × 2.
Fig. 8. " " tail-fan, dorsal view, × 8.



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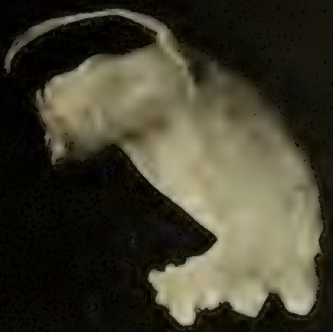
HELIOTYPE CO. BOSTON

PLATE 3.

Fig. 9. Barbouria poeyi, mandible, × 20.
Fig. 10. “ “ palp of mandible, × 26.
Fig. 11. “ “ first maxilla, proximal endite, × 20.
Fig. 12. “ “ first maxilla, distal endite, × 20.
Fig. 13. “ “ first maxillae, proximal endites covering the mandibles, × 20.



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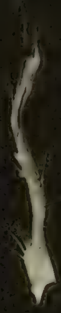

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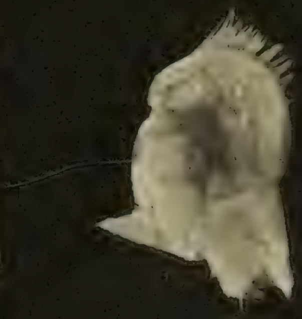

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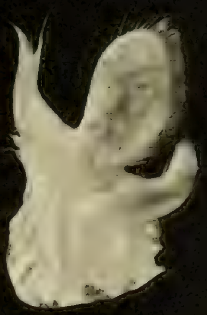

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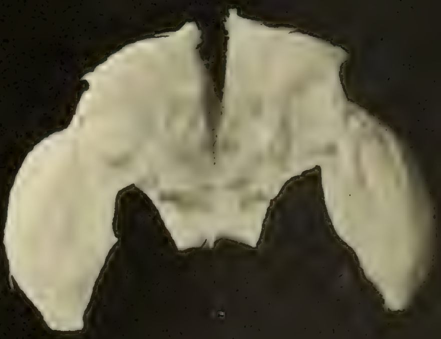

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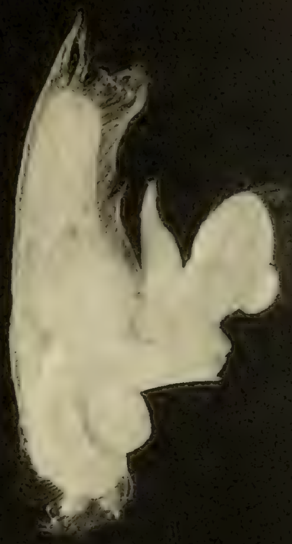
HELIOTYPE CO. BOSTON

PLATE 4.

Fig. 14. Barbouria poeyi, second maxilla, × 20.
Fig. 15. " " first maxilliped, × 20.
Fig. 16. " " second maxilliped, × 20.
Fig. 17. " " third maxilliped, × 8.



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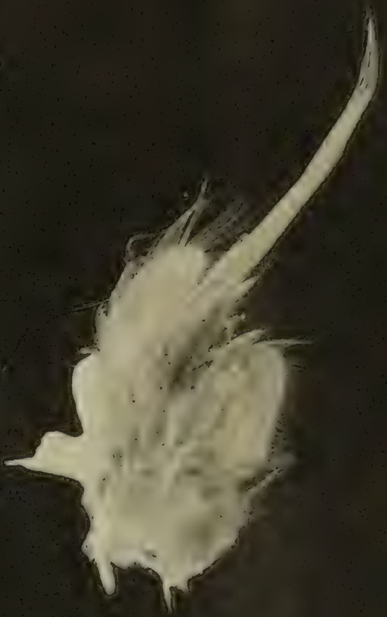

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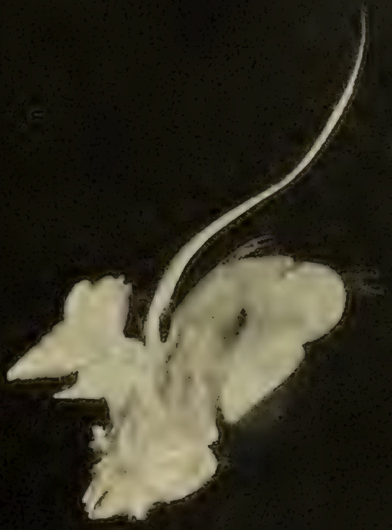

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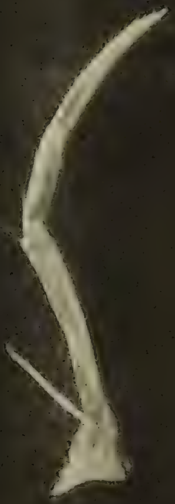

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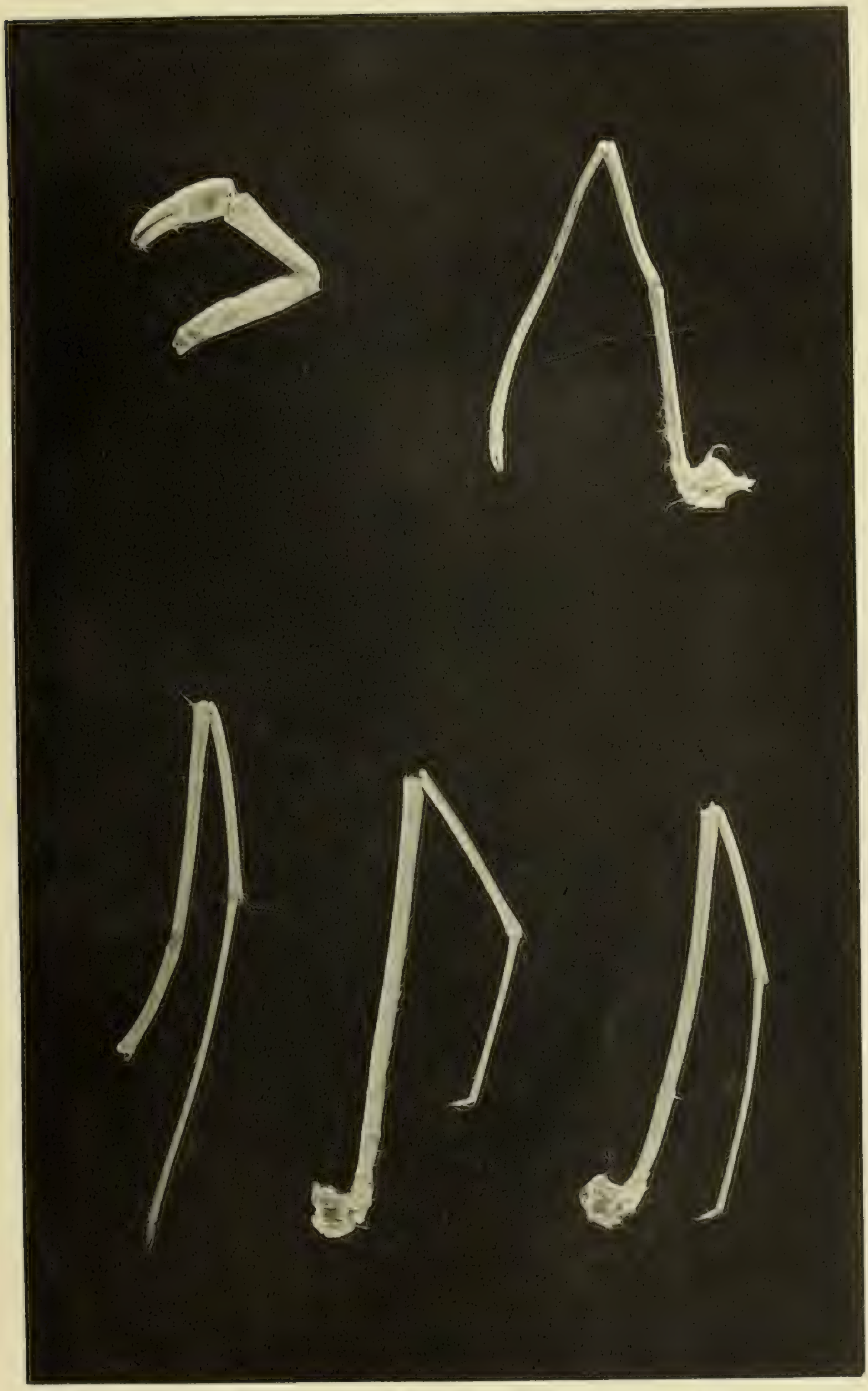
PLATE 5.

Fig. 18. Barbouria poeyi, first pereiopod, × 8.
Fig. 19. " " second pereiopod, × 8.
Fig. 20. " " third pereiopod, × 8.
Fig. 21. " " fourth pereiopod, × 8.
Fig. 22. " " fifth pereiopod, × 8.



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HELIOTYPE CO. BOSTON

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
Vol. LIV. No. 16.

SOME BIRDS FROM THE HIGHLANDS OF SIBERIA.

By Outram Bangs.

CAMBRIDGE, MASS., U. S. A.:
PRINTED FOR THE MUSEUM.
January, 1913.

No. 16.— *Some Birds from the Highlands of Siberia.*

By Outram Bangs.

In the summer of 1912 Dr. Theodore Lyman of Harvard University brought to pass a long-planned trip to the Altai Mountains, Siberia and Mongolia. The excursion combined hunting and collecting, and the material gathered has been shared between the United States National Museum and the Museum of Comparative Zoölogy, the mammals to Washington and the birds and other animals to Cambridge. Both museums have profited much by Dr. Lyman's generosity, material from central Asia being among the chief desiderata of each institution.

On this trip Mr. N. Hollister, Assistant Curator of Mammals at the U. S. National Museum, and Mr. Conrad Kein, a mountaineer and hunter of long experience and great skill, accompanied Dr. Lyman. They trapped, shot, and prepared the smaller animals while Dr. Lyman devoted most of his time to a successful search for the great sheep and other large game mammals.

No less than 287 beautifully prepared bird skins and almost exactly the same number of mammals were made by the indefatigable Hollister who worked in his tent literally day and night upon the material Kein shot and trapped. Only five weeks were spent in actual collecting and the results are astonishing.

Mr. Hollister in three short papers[1] has described the new mammals taken by the party, and a complete list will be published later.

A good deal has already been written about the birds of the Altai Mountains, but it appears that here, as well as in other remote parts of the world, there is yet opportunity for close work by skilful field naturalists; three of the birds taken prove to belong to undescribed forms.

The birds were all taken at three collecting stations. The first of these, the Tchegan-Burgazi Pass, is in a uniform desert mountain region without trees except for a few scattering larches in sheltered cañons. The main camp here was at an altitude of 8,300 feet; about this and up the surrounding peaks to 12,000 feet collecting was carried on from July 1 to July 26.

One day's collecting only, July 28, was spent at the second camp in the Chuisaya Steppe, 12 versts (= 8 miles) south of Kosh-Agatch. This was a flat desert of 7,300 feet altitude with very little vegetation, except for a few scrub willows and dwarf thorn bushes growing along the banks of the streams — the Tchegan-Burgazi River and tributaries.

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[1] Smithsonian misc. coll., Nov. 29, 1912, **60**, p. 1–6. Proc. Biol. soc. Washington. Dec. 24, 1912, **25**, p. 181–184; Jany. 18, 1913, **26**, p. 1–4.

The third stop was made at Topucha where specimens were gathered from August 5 to August 10 inclusive. This place is at an altitude of 6,875 feet, in heavy forest, largely coniferous. It rained hard most of the time the party was camped here, and was very cold and damp, apparently the normal weather conditions of the region.

Mr. Hollister informs me that the party secured specimens of most of the birds that were seen, the exceptions being large wary species such as the Lämmergeyer which was often seen. A falcon (perhaps *Hierofalco altaicus* Menzbier) was observed on several occasions, always at a distance, and Dr. Lyman once, when hunting sheep, started from among the rocks, one individual of *Tetraogallus altaicus.*

In identifying the 52 forms enumerated in the following list, I have had for comparison some material from the U. S. National Museum and also from the American Museum of Natural History, and I would express my thanks to the authorities of these institutions.

Note: — The order followed is that of Sharpe's Hand List of Birds, and the measurements are in millimeters.

TETRAONIDAE.

Lagopus lagopus lagopus (Linné).

One adult male, shot July 13, on the alps above Tchegan-Burgazi Pass, at 9,500 feet. It was one of a pair that had with them a brood of young. They were in smooth country, in a place where there were no rocks.

Tetrastes bonasia septentrionalis (Seebohm).

One young male, Topucha, August 7. This example is nearly full grown, with the adult feathers appearing in the tail and in places on the body. It is, however, too young for positive identification and I refer it to the above subspecies on geographic grounds only.

It was shot by Dr. Lyman, with his rifle, from a covey which he flushed in the thick forest. Afterwards both he and Mr. Kein hunted assiduously but were unable to find either this covey or another.

COLUMBIDAE.

Columba rupestris pallida Roth. and Hartert.

Six adults, both sexes, Tchegan-Burgazi Pass, July 2 to July 10. The rock pigeon was very common in the higher parts of the mountains, being especially numerous among the cliffs along the Tchegan-Burgazi River.

CHARADRIIDAE.

Eudromias morinellus (Linné).

One adult male, taken at Topucha, August 10.

Aegialitis dubia (Scopoli).

Two specimens, Tchegan-Burgazi Pass, an adult male taken July 15 and a young male not yet able to fly July 22.

Actitis hypoleucus (Linné).

Twelve specimens, Tchegan-Burgazi Pass, adults of both sexes and young of various ages from those just hatched to others quite able to fly, July 2 to July 26.

ANATIDAE.

Mergus merganser comatus (Salvadori).

One adult female taken on the bank of Black Creek, a tributary to the Tchegan-Burgazi River, July 2.

FALCONIDAE.

Buteo buteo plumipes (Hodgson).

Three specimens, an old female, and youngish male and female, Topucha, August 5, 8, and 9.

Falco aesalon lymani, subsp. nov.

Seven specimens, Tchegan-Burgazi Pass, adults of both sexes, and downy young. One nest was found in a larch tree, on a branch 15 feet from the ground and close to the trunk, July 12, containing two downy young and a broken egg. The old female and the two young were secured. Another nest in an exactly similar position, also in a larch, was discovered July 10; both old birds, two downy young and one egg were taken.

The downy young can be separated from those of the kestrel by their being clothed in dull grayish down, whereas young kestrels of the same age wear a coat of whitish.

Cotypes, from Tchegan-Burgazi Pass, Altai Mountains, Siberia. A mated pair of adults, Nos. 57,672 ♂ and 57,673 ♀, M. C. Z. Collected July 10, 1912, by N. Hollister.

Characters. The chief character of this new form is its very long wings and tail — each of which are about an inch longer, than in corresponding sexes, of any of the other races of the merlin. Colors above about as in *F. aesalon pallidus* (Suschkin) *or even paler*, comparison with *F. aesalon aesalon* Tunstall of Europe is therefore unnecessary. On the under surface the darker markings are very small and much blended with the ground color, producing a very pallid effect.

Measurements.

No.	*Sex*	*Wing*	*Tail* (feathers)	*Tarsus*	*Culmen from front of cere*	*Middle toe without claw*
57,672	♂ ad.	226	136	35.	12.	27.5
57,673	♀ ad.	249	146	36.5	13.5	30.
57,676	♀ ad.	252	150	38.	14.	30.5

Comparing these measurements with those of merlins from elsewhere it is at once seen that the wings and tail of the Altai bird are very long; the foot decidedly small; the tarsus and bill no longer. The proportions of the bird are therefore quite different.

Remarks. Two forms of the merlin recently described are — *Lithofalco aesalon pallidus* Suschkin,[1] which in the breeding season occupies the Kirghiz Steppes, the valleys of the Ural River and tributaries, and the Mugodjar range, and winters in Turkestan and N. W. India, and *Aesalon regulus insignis* Clark [2] of Korea.

Comparing the type of *insignis* with a specimen of *pallidus* from eastern Turkestan in exactly similar plumage, I find myself unable to distinguish them. Again an adult male taken in winter at Tokio, Japan, agrees almost exactly with an adult male of *pallidus* taken

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[1] Bull. B. O. C., 1901, **11**, p. 5.

[2] Proc. U. S. nat. mus., June 15, 1907, **32**, p. 470.

January 20, at Shigar, Kashmir. Other specimens from Japan and Korea are darker, and more nearly approach European birds as do two skins from middle China. All specimens from east to west except the Altai Mountain birds, are very uniform in size, specimens from Great Britain agreeing in this respect exactly with those from Korea, and with examples of *F. a. pallidus.*

The long series of skins now before me, which includes beside the M. C. Z. material, all the specimens in the U. S. National Museum and the American Museum of Natural History, shows very clearly three well-marked races:— *Falco aesalon aesalon* Tunstall, *F. a. pallidus* (Suschkin), and *F. a. lymani,* subsp. nov. A still larger suite of specimens might reveal additional races, as it is difficult to allow that the birds from Korea and the Kirghiz Steppes are really identical.

Under the old rule of once a synonym always a synonym, Dr. Suschkin's name *pallidus* is rendered untenable by *Falco pallidus* Schl. and Susem., a synonym of *Circus macrurus.* A name, that should be considered in this connection also, is *Falco sibiricus* Shaw. The description indicates a merlin, pale in color both above and below and said to inhabit Siberia.

CERCHNEIS TINNUNCULUS TINNUNCULUS (Linné).

Nine specimens, Tchegan-Burgazi Pass, adults of both sexes and downy young. July 9 to July 25. One nest of the kestrel was found, July 12. This was on a branch of a larch, 10 feet from the ground, and 4 feet out from the trunk of the tree. It was built of sticks and dried grasses and was nearly completely roofed over. Perhaps it was an old magpie's nest which the kestrels had made use of. It contained four downy young and one egg, all of which together with the parent birds, were secured.

I cannot distinguish the kestrel of this region from the European specimens I have compared it with.

STRIGIDAE.

BUBO BUBO TURCOMANUS (Eversmann).

One old female and two young males, still in the down, but with wing and tail feathers just beginning to grow out, were taken at Tchegan-Burgazi Pass, July 7.

The old female had been seen several times near camp perched on the top of a high rocky spire; Mr. Kein finally climbed the peak and caught the bird in a trap. The two young birds were found in a tree near by.

Strix uralensis sibirica (Tschusi).

One adult female, Topucha, August 9, was shot by Dr. Lyman with a rifle. The type locality of this well-marked form is Tomsk, our specimen is therefore practically a topotype. Tschusi's name however, *Syruium uralense sibiricum,* Orn. Jabrbuch, 1903, **14**, p. 166, cannot be used because this group of owls must be known by the generic term *Strix,* and in that event is preoccupied by *Strix sibiricus* Schlegel and Susem. I have not material enough at my command to decide whether or not *Syruium uralense nikolskii* Buturlin, Psovaia i Rujlinaia Okhota, 1907, **13**, no. 7, from S. E. Siberia is the same. If not then Tschusi's bird must receive a new name.

UPUPIDAE.

Upupa epops saturatus Lönnberg.

One adult female, from the head of Black Creek near the Tchegan-Burgazi Pass, July 6.

CUCULIDAE.

Cuculus optatus Gould.

Two specimens, Tchegan-Burgazi Pass, a male in nearly adult plumage and an immature bird (sex not determined), July 17 and July 25.

TURDIDAE.

Turdus viscivorus bonapartei Cabanis.

One male, Topucha, August.

Turdus atrigularis (Temminck).

Fourteen specimens, young and adults of both sexes. Topucha and Tchegan-Burgazi Pass, July 14 to August 10.

MONTICOLA SAXATILIS (Linné).

Six specimens, young and adults of both sexes, Tchegan-Burgazi Pass, July 11 to July 25.

PRUNELLA FULVESCENS FULVESCENS (Severtzoff).

Twenty-two specimens, young and adults of both sexes, Tchegan-Burgazi Pass, July 3 to July 24.

PHOENICURUS PHOENICURUS PHOENICURUS (Linné).

One adult male, Topucha, August 10. Probably a migrant.

PHOENICURUS OCHRURUS PHOENICUROIDES (Moore).

Twelve specimens, adults and young of both sexes, Tchegan-Burgazi Pass. July 11 to July 24.

PHOENICURUS ERYTHRONOTUS (Eversmann).

One ♂ Topucha, August 7.

CYANOSYLVIA SUECICA DISCESSA (Madarász).

Ten specimens, including young and adults of both sexes, Tchegan-Burgazi Pass. July 6 to July 24.

PRATINCOLA TORQUATA INDICA Blyth.

Two specimens, an adult male, Topucha, August 7 and a young female Tchegan-Burgazi Pass. July 26.

SAXICOLA OENANTHE OENANTHE (Linné).

Twenty-five specimens, adults and young of both sexes, Tchegan-Burgazi Pass, July 2 to July 26. The wheatear was one of the commonest birds of the desert mountain region.

SAXICOLA ISABELLINA Cretzschm.

Four specimens, an adult male and three youngish examples, Tchegan-Burgazi Pass. July 7 to July 15. This much more robust species was found in the same regions with *oenanthe* but was very rare comparatively.

SAXICOLA DESERTI ALBIFRONS Brandt.

Two adult males, Chuisaya Steppe, July 28.

SYLVIIDAE.

ANTELIOCICHLA AGRICOLA AGRICOLA (Jerdon).

One adult female, Topucha, August 5.

SYLVIA CURRUCA AFFINIS Blyth.

One adult female, Topucha, August 8.

PHYLLOSCOPUS COLLYBITA ABIETINA (Nilsson).

Thirteen specimens, adults of both sexes, Tchegan-Burgazi Pass and Topucha, July 1 to August 9. Examples were taken in the scattering larches up to 8,650 feet.

LANIIDAE.

LANIUS CRISTATUS PHOENICUROIDES (Schalow).

Two males, neither quite adult, Topucha, August 8 and 9.

PARIDAE.

POECILE CINCTUS SAYANA Suschkin.

Two adults, male and female, taken at Topucha, August 7 and 8. These two birds were in much abraded plumage and the color characters are therefore not very obvious, but the large bill is noticeably different from that of *P. c. cinctus* (Boddaert) or *P. c. obtectus* Cabanis.

SITTIDAE.

SITTA EUROPAEA URALENSIS Gloger.

Four specimens, both sexes, Topucha, August 6 to August 9.

MOTACILLIDAE.

MOTACILLA ALBA PERSONATA Gould.

Ten specimens, adults of both sexes and one young in nestling plumage, Tchegan-Burgazi Pass, July 2 to July 20.

BUDYTES CITREOLA (Pallas).

Nine specimens, adults and young in nestling plumage of both sexes, Tchegan-Burgazi Pass, July 4 to July 23.

B. citreoloides Gould, usually given as a breeding bird of the Altai Mountains was not met with.

ANTHUS HODGSONI Richmond.

Two specimens, Topucha, one an adult female taken August 8, the other a young female in nestling plumage, August 5.

ANTHUS TRIVIALIS (Linné).

One adult female, in very much worn plumage, but still unmistakably belonging to this species, Topucha, August 6.

It was of interest to find both the eastern and western tree pipits in the same place in the breeding season, but Oates (Fauna of British India, Birds, **2**, p. 303) says that a few birds of this species (*A. trivialis*) appear to breed in the Himalayas.

ANTHUS SPIPOLETTA BLACKISTONI Swinhoe.

Twenty-eight specimens, adults and young of both sexes, Tchegan-Burgazi Pass, July 1 to July 26.

ALAUDIDAE.

OTOCORIS ALPESTRIS BRANDTI Dresser.

Ten adults, both sexes, Tchegan-Burgazi Pass, and Chuisaya Steppe, July 2 to July 28. All were taken at altitudes of between 7,300 and 9,000 feet.

I know *O. alpestris montana* Bianchi by description only, but I do not think any in our series at all approach it.

FRINGILLIDAE.

ACANTHIS FLAVIROSTRIS BREVIROSTRIS (Moore).

Nineteen specimens adults of both sexes, and two two thirds grown young, Tchegan-Burgazi Pass. July 18 to July 24.

MONTIFRINGILLA NEMORICOLA ALTAICA Eversmann.

Three adults, both sexes, Tchegan-Burgazi Pass, July 13 to 21.

ERYTHROSPIZA MONGOLICA (Swinhoe).

One pair of adults, taken July 28 at Chuisaya Steppe.

PETRONIA PETRONIA BREVIROSTRIS Taczanowski.

One pair of adults, taken July 12 at Tchegan-Burgazi Pass.

CARPODACUS ERYTHRINUS ROSEATUS (Hodgson).

Four adults, one male, three females, Topucha, at about 7,000 feet, August 7 and 8.

CARPODACUS RHODOCHLAMYS RHODOCHLAMYS (Brandt).

One male, not quite adult, Topucha, August 7.

PINICOLA ENUCLEATOR PACATA, subsp. nov.

Type, and only specimen, from Topucha, Altai Mountains, Siberia, No. 57,927, adult ♂, M. C. Z. Collected August 7, 1912, by N. Hollister.

Characters. Colors apparently[1] as in *P. enucleator kamtschatkensis* Dybowski, *i. e.* very slightly brighter than in *P. e. enucleator* (Linné) of northern Europe. Bill (Fig. 2) very different from that of either. It is nearly as long as in *P. e. enucleator* (Fig. 1), but is very thin, small, and tapering, and needs no comparison with the short, stubby, high bill of *P. e. kamtschatkensis* (Fig. 3).

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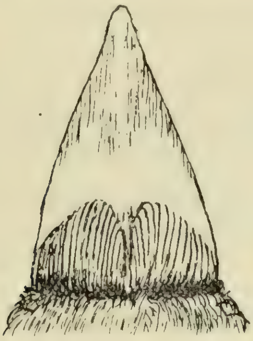
[1] The one example is in full breeding plumage. In this stage, in all pine grosbeaks, the colors are dark and intensified from the wearing away of the tips of the feathers.



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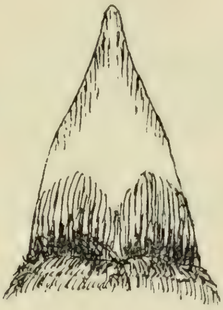

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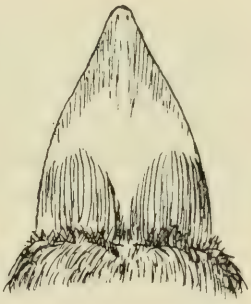

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FIG. 1. *Pinicola enucleator enucleator* (Linné). No. 30,784 M. C. Z. ad. ♂.
FIG. 2. *Pinicola enucleator pacata* Bangs. Type No. 57,927 M. C. Z. ad. ♂.
FIG. 3. *Pinicola enucleator kamtschatkensis* (Dyb.) No. 77,210. Amer. Mus. Nat. Hist. ad. ♂.

Measurements.

Type, adult ♂, no. 57,927, wing, 103; tail, 82; tarsus, 21.5; culmen, 15.

Remarks. It is to be regretted that only one specimen was taken, but the character of the bill is so constant in large series of the two other Eurasian forms of pine grosbeak and without resemblance to the shape shown in the Altai bird, that I have no hesitation in adding a third race.

EMBERIZA HORTULANA Linné.

One adult male Tchegan-Burgazi Pass, July 23. *E. buchanani* Blyth was not seen by any of the party. I suppose, like many other birds given as the breeding forms of the Altai Mountains, its range is really limited to the Mongolian slopes of the mountains.

CORVIDAE.

CORVUS CORAX LAURENCEI Hume.

This raven was not taken, but a skull, with most of the feathers was saved from the remains of a dead bird found at Topucha, August 8. So far as I can decide by the skull alone the raven of the region appears to be nearer *laurencei* than to any of the other forms.

CORVUS CORONE ORIENTALIS Eversmann.

One youngish male, Tchegan-Burgazi Pass, July 21.

NUCIFRAGA CARYOCATACTES ROTHSCHILDI Hartert.

Six adults, both sexes, Topucha, August 5 to 9.

The nutcracker of the region I refer, without much doubt, to the above form, of which, however, I have seen no specimens. Our series seems to indicate that the Altai bird is not quite extreme *rothschildi* but that it tends a little toward *N. c. macrorhynchus* Brehm.

PICA PICA BACTRIANA Bonaparte.

Two females, Tchegan-Burgazi Pass. July 19 and 20.

PERISOREUS INFAUSTUS OPICUS, subsp. nov.

Three specimens, adult male and female and young male, Topucha, August 8 and 10.

Type from Topucha, Altai Mountains, Siberia, No. 57,701 adult ♂, M. C. Z. Collected, August 8, 1912, by N. Hollister.

Characters. Similar in general to *P. infaustus infaustus* (Linné). of northern Europe, but distinguished at once by the pileum, upper cheeks, and lores being *black* instead of *brown;* the black cap also abruptly defined against the grayish of the hind neck, whereas in *P. i. infaustus* the brown cap merges gradually into the color of the hind neck. No comparison, of course, with the large, pale grayish form, *P. infaustus sibericus* (Boddaert), of east Siberia and Kamchatka is needed.

Measurements.

No.	*Sex*	*Wing*	*Tail*	*Tarsus*	*Culmen*
57,701	♂ ad. type	144.	142.	38.	25.
57,702	♀ ad. topotype	141.	137.	35.5	23.

PYRRHOCORAX PYRRHOCORAX (Linné).

Eight specimens, adults and young of both sexes Tchegan-Burgazi Pass. July 1–July 18. The chough was abundant, especially so in the rocky cliffs at about 9,000 feet elevation.

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THE ANTS OF CUBA.

By William Morton Wheeler.

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No. 17.— *The Ants of Cuba.*[1]

By William Morton Wheeler.

Myrmecologists have been inclined to assume that Cuba, as the largest of the Antilles, would yield, on careful exploration, a large and interesting ant-fauna. I, too, shared this opinion, although I had found that Porto Rico, the Virgin Islands, the Bahamas and Jamaica are very far from being as rich in species as equal areas of Central and tropical South America. But a visit of a few weeks to Cuba, in company with Dr. Thomas Barbour and Mr. L. A. Shaw, during January and February, 1913, has convinced me that Cuba, in proportion to its size, must be even poorer in ants than Jamaica, Porto Rico, and Haiti.[2]

Guérin (1845) and Mayr (1862) were the first to record a few ants from Cuba, but a much larger series was described by Roger in 1863. His specimens were collected by the celebrated Juan Gundlach, but no precise data that might guide the future collector to the type localities, were recorded. Within more recent years a few species or varieties have been added by Forel and Santschi.

On arriving in Havana I had the pleasure of meeting the talented Cuban naturalist Prof. Carlos de la Torre y Huerta, who very kindly helped me to an appreciation of Gundlach's work. He not only loaned me the manuscript note-book of Gundlach in his possession, but also conducted me to this naturalist's collection in the Istituto de Seconda Enseñanza and secured for me copies of two publications containing valuable data on the Cuban ants. These papers comprise the second part ("Hymenopteros") of Gundlach's work on the insects of Cuba and the "Catalogo Numerico del Museo Zoologico Cubano (Museo Gundlach)," published by A. Alvarez y Comp. Havana, 1895. With the aid of these papers and the note-book above mentioned I have been able to ascertain the precise localities in which many of Roger's types were collected. It appears that Gundlach sent a second lot of ants to Roger and that this myrmecologist died before he could study or return them. A few of them, as indicated by the remark

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[1] Contributions from the Entomological laboratory of the Bussey institution, Harvard University, No. 66.

[2] Mr. W. M. Mann has recently made a very fine collection of ants in Haiti. We hope to be able to describe and list these in the near future.

"se perdió por la muerte de Roger" opposite their numbers in the note-book, were uniques and were irretrievably lost, but numbered duplicates of several, without names, are still in the Gundlach collection. This collection in its entirety is preserved in a small sealed box which cannot be opened. I was compelled, therefore, to study the specimens, which are carded, through the glass lid, and this is at such a distance from the specimens as to prevent satisfactory examination of fine structural details, especially in the smallest species, with a pocket lens. Still it is possible to recognize most of the species readily, and I have even described two new species of Macromischa from the collection, with sufficient detail, I trust, to enable any future myrmecologist to recognize them.

It will be remembered that Gundlach was a very painstaking and industrious naturalist, that he collected for many years and in many parts of Cuba, and that he also received insects from his friend, another Cuban naturalist, Felipe Poey. From these facts alone we may infer that Gundlach's ant collection was reasonably complete so far as the more common and more conspicuous Cuban species are concerned. My own brief acquaintance with a limited portion of the island only strengthens this inference. I have never collected in a region in which ants, apart from a few widely distributed species, are so scarce. Any one of our New England states is richer in colonies of these insects than this large tropical island, and I may add, quite as rich in species. That I have been able to find several forms not seen by Gundlach is in part due to the fact that he was not aware that many of the species nest as timid colonies in hollow twigs and that some are nocturnal. His collection, therefore, does not contain such common species as *Camponotus ramulorum, Tapinoma litorale, Pseudomyrma delicatula,* etc. Moreover, the nine beautiful species of Macromischa which save the Cuban ant-fauna from being utterly commonplace, and which almost certainly nest in hollow twigs, are each represented by only one or two stray worker specimens which he probably found in sweepings or running on bark or leaves.

Of the forty-four forms listed by Gundlach, two, *Heptacondylus sulcatus* Mayr and *Polyrhachis cubaënsis* Mayr were erroneously described as Cuban. The former is a synonym of *Myrmicaria eumenoides* Gerstaecker from South Africa and the latter is also from the same region. Omitting these, it will be seen that the list in the present paper adds thirty-five forms. The total number seventy-seven of ants now known from Cuba may be separated into three groups:— first, forms known only from this island and therefore to be regarded, at least provisionally, as indigenous; second, forms known also from the neighboring islands or from the adjacent mainland (Florida, Mexico, Central and northern South America); and third, tropicopolitan forms of Old World origin comprising the "tramp" species which have been introduced into the island by commerce.

The indigenous forms, thirty-four in number and comprising 44.1% of the Cuban ant fauna, are the following:—

Euponera succedanea
Leptogenys falcata
Pseudomyrma opacior
“ *pazosi*
“ *cubaënsis*
Monomorium cinnabari
Macromischa purpurata
“ *porphyritis*
“ *squamifera*
“ *versicolor*
“ *iris*
“ *lugens*
“ *punicans*
“ *gundlachi*
“ *poeyi*
Crematogaster sanguinea
“ *torrei*
Pheidole cubaënsis
“ *bakeri*
“ *barbouri*
Solenopsis cubaënsis
Atta insularis
Strumigenys gundlachi
Tapinoma cubaënsis
Plagiolepis flavidula
Prenolepis anthracina
“ *gibberosa*
Myrmelachista kraatzi
“ *rogeri*
Camponotus mestrei
“ *sphaericus*
“ *sphaeralis*
“ *gilviventris*
“ *riehli.*

Of these the most striking are the nine species of Macromischa, which show that Cuba is the center of distribution of this genus, the large *Atta insularis,* the only *Atta sens. str.* known to occur in the West Indies, and the small section of the genus Camponotus comprising the two peculiar species *C. sphaericus* and *sphaeralis.*

The following forms, thirty-six in number and constituting 46.7% of the ant-fauna, are more or less widely distributed through the West Indies and tropical continental America:—

Platythyrea punctata
Euponera stigma
Ponera ergatandria
“ *opaciceps*
“ *opacior*
Odontomachus insularis
“ *pallens*
Odontomachus ruginodis
Pseudomyrma pallida
“ *delicatula*
Wasmannia auropunctata
Pheidole fallax
“ *flavens*
Solenopsis geminata

Solenopsis virgula
Atta octospinosa
“ *borinquenensis*
Cyphomyrmex minutus
Cryptocerus varians
Strumigenys rogeri
“ *alberti*
Epitritus emmae
Prenolepis fulva
“ *fumata*
“ *vividula*
Prenolepis antillana
“ *steinheili*
“ *minuta*
Iridomyrmex pruinosus
“ *analis*
Dorymyrmex pyramicus
“ *niger*
Camponotus santosi
“ *inaequalis*
“ *ramulorum*
“ *planatus*

A considerable number of these occur also in the southern United States, especially in Florida, and in the Bahamas. Many of them may be very ancient inhabitants of Cuba.

The tropicopolitan species are seven in number, or 9% of the Cuban ant-fauna, namely:—

Monomorium pharaonis
“ *floricola*
Cardiocondyla emeryi
Tetramorium guineense
Pheidole megacephala
Tapinoma melanocephalum
Prenolepis longicornis

The only strictly indigenous species which behaves as a dominant insect, at least throughout the lowlands of the island, is *Atta insularis;* the others are rare or local and, being nearly all very small, timid ants, have probably suffered considerably from the inroads of such dominant and predatory forms as *Pheidole megacephala, Solenopsis geminata, Prenolepis longicornis, Dorymyrmex niger, Iridomyrmex pruinosus,* and *Tapinoma melanocephalum.* Most or all of these have probably been introduced into Cuba within comparatively recent times.

A more detailed discussion of the bearing of the composition of the Cuban ant-fauna on the general distribution of these and other insects in the West Indies and on the geological history of these islands, cannot be profitably undertaken till the fauna of Haiti and San Domingo has been studied. A knowledge of this fauna and of some of the Lesser Antilles from which I have recently received specimens, together with the data I have already published on the ant-faunas of Porto Rico, Jamaica, and the Bahamas, may be expected to aid us in the solution of some of the problems of West Indian zoögeography.

In addition to the Gundlach and other published records and those taken from specimens collected by myself, I have included in this paper a number of valuable records from specimens received from Profs. C. F. Baker, and C. H. Eigenmann and Messrs. E. A. Schwarz, Aug. Busck, F. Rose, E. Palmer and C. V. Riley, and Patricio Cardin.

FORMICIDAE.

PONERINAE.

1. PLATYTHYREA PUNCTATA (F. Smith).

Pachycondyla punctata F. Smith, Cat. Hymen. Brit. mus., 1858, **6**, p. 108 ☿ ♂.

This species was taken by Gundlach at Baracoa, in the Province Oriente. His collection contains a single worker (no. 318).

2. EUPONERA (TRACHYMESOPUS) STIGMA (Fabricius).

Formica stigma Fabr. Syst. Piez., 1804, p. 400 ♀.

Gundlach says that he took this species in various localities in the western portion of the island. His collection contains two males, one female, and a worker (no. 128). I have taken the species in the Cienaga de Zapata near Bolondron and along the Rio Hanabana under old logs.

3. EUPONERA (TRACHYMESOPUS) SUCCEDANEA (Roger).

Ponera succedanea Roger, Berl. ent. zeitschr., 1863, **7**, p. 170 ☿ ♀ ♂.

Gundlach gives Bayamo as the locality of this form. His collection contains a male, female, and worker specimen (no. 322). These, so far as I was able to judge, are scarcely distinct from *E.* (*T.*) *stigma.* Roger's description gives a number of differences, especially in the shape of the petiole and frontal carinae, but the value of these characters can be determined only by the examination of more material.

4. PONERA ERGATANDRIA Forel.

Trans. Ent. soc. London, 1893, p. 365 ☿ ♀ ♂.

A single worker taken under a log on the banks of the Rio Hanabana in the Cienaga de Zapata.

5. PONERA OPACICEPS Mayr.

Verh. Zool. bot. gesellsch., 1887, **37**, p. 536 ☿ ♀.

I have taken several workers of this species under logs in moist places in the Cienaga de Zapata near Bolondron. A winged female from Cayamas (E. A. Schwarz) in my collection is also referable to this species.

6. PONERA TRIGONA Mayr var. OPACIOR Forel.

Trans. Ent. soc. London, 1893, p. 363 ☿ ♀.

Two workers from San Francisco de Morales in the Cienaga de Zapata. These were taken in a moist spot under a log.

7. LEPTOGENYS MAXILLOSA F. Smith var. FALCATA Roger.

Leptogenys falcata Roger, Berl. ent. zeitschr., 1861, **5**, p. 42 ☿.

Gundlach took this ant in various localities in the western part of the island, but only Havana and Firmina are cited in the note-book. The collection contains a male and a worker specimen, with the no. 234.

8. ODONTOMACHUS HÆMATODA (Linné) subsp. INSULARIS Guérin.

Odontomachus insularis Guérin, Iconogr. régn. anim., 1845, **7**, p. 423 ☿.

Several workers received from Mr. Patricio Cardin, who took them at Santiago de las Vegas, near Havana, are referable to the typical form of this subspecies. They are small, dark colored, rather hairy and pubescent and have the posterior surface of the petiole smooth.

9. ODONTOMACHUS HÆMATODA (Linné) subsp. INSULARIS Guérin var. PALLENS Wheeler.

Bull. Amer. mus. nat. hist., 1905, **21**, p. 82 ☿ ♀ ♂.

The specimens of *O. haematoda* in the Gundlach coll. (one male, one female, and one worker with the no. 90) belong to this pale variety. Gundlach states that he took it in both halves of the island.

I have taken it at Cogimar, near Havana, Aguada de Pasajeros, Bolondron, and at several localities in the Cienaga de Zapata (Sarabanda, Rio Hanabana, and San Francisco de Morales) and have seen specimens from Baracoa (Aug. Busck), Havana (C. H. Eigenmann) and El Guama, in the Province of Pinar del Rio (Palmer and Riley). It is certainly one of the commonest of Cuban ants, nesting under stones and logs or in indistinct crater nests about the roots of plants. Winged females were found in several of the nests during the first weeks of February.

10. ODONTOMACHUS HAEMATODA (Linné) subsp. INSULARIS Guérin var. RUGINODIS Wheeler.

Bull. Amer. mus. nat. hist., 1905, **21**, p. 82 ☿ ♀.

This variety, which is darker than the preceding and has the posterior surface of the petiole transversely rugose, was taken in the Botanical Garden in the city of Havana. I have also received specimens from the Province of Havana (C. F. Baker) and from Cayamas (E. A. Schwarz).

MYRMICINAE.

11. PSEUDOMYRMA LATINODA Mayr var. OPACIOR Forel.

Ann. Soc. ent. Belg., 1904, **48**, p. 170 ☿.

This variety was described from a single worker from Cuba (coll. Ballion *ex* coll. Puls). It is allied to the var. *nigrescens* Forel but differs from this and from the typical form of the species in having the body, and especially the head, more strongly punctate and from *nigrescens* in having the epinotum less angular. Forel was in doubt as to whether *opacior* should not rank as a subspecies.

12. PSEUDOMYRMA PALLIDA F. Smith.

Trans. Ent. soc. London, 1855, ser. 2, **3**, p. 159 ☿.

Gundlach took this species in the environs of Cardenas. He states that it and the other species of the genus are popularly called "muerdehuye." His note-book adds the localities Guanabo and Yatimo.

The collection contains three workers with the no. 273. They evidently belong to the species which has been passing in the literature as *pallida* Smith, being pale yellow, without black spots on the first gastric segment.

13. PSEUDOMYRMA FLAVIDULA F. Smith var. DELICATULA Forel.

Ps. delicatula Forel, Biol. Centr. Amer., 1899, p. 93, tab. 4, fig. 6 ☿ ♀.

This, I believe, is merely a small variety of *Ps. flavidula* and not a distinct species. A fine colony, containing a male and several winged females was taken during the last week of January at Cogimar, near Havana, in the thin twig of a bush.

14. PSEUDOMYRMA FLAVIDULA F. Smith var. PAZOSI Santschi.

Ps. pazosi Santschi, Bull. Soc. ent. France, 1909, p. 309 ☿ ♀.

This form which is, in my opinion, merely a color variety of *flavidula*, with the whole gaster of the female and worker black instead of being yellow like the head and thorax and with two black spots on the basal segment, was described from specimens taken at San Antonio de los Baños by Dr. Pazos. It is, however, a very constant variety, and seems to be widely distributed at least in the western half of the island. I have taken it nesting in the hollow twigs of trees and bushes and running on bark in various localities near and in the Cienaga de Zapata (Bolondron, Rio de Hanabana, Aguada de Pasajeros) and have long had in my collection two workers and a winged female taken by Prof. C. F. Baker at Cayamas and a worker taken in the same locality by Mr. E. A. Schwarz. Two workers were also recently sent to me from Galatre, in the Province of Pinar del Rio by Messrs. T. E. Holloway and G. N. Wolcott. A single worker (no. 136) marked Pseudomyrma sp. in Gundlach's collection shows that he recognized this form as distinct.

15. PSEUDOMYRMA ELONGATA Mayr var. CUBAËNSIS Forel.

Ann. Soc. ent. Belg., 1901, **45**, p. 342 ☿.

Forel gives the following diagnosis of this form:— "Differs from the typical form in having a much longer pedicel. The petiole, especially, is much longer than broad, less elevated, with its posterior declivity oblique like the anterior. The postpetiole is rather longer than broad. The head is still narrower and more elongate than in the type: the antennae are still shorter and thicker. The median funicular joints are extremely transverse, much broader than long, in part almost $1\frac{1}{2}$ times broader. Finally, the frontal furrow is distinctly marked. The color is blackish brown, pruinose with pubescence." The types are from Bahia Honda (M. J. Schmitt).

This is certainly the most abundant of the Cuban Pseudomyrmas. I have seen it running on tree trunks and nesting in their twigs at Cogimar, near Havana, at Bolondron, Aguada de Pasajeros, in many localities in the Cienaga de Zapata (Rio Hanabana, San Francisco de Morales, Sarabanda, etc) and have received specimens from Cayamas (C. F. Baker and E. A. Schwarz). That it was known to Gundlach as a distinct form is shown by a worker specimen (no. 208) marked "Pseudomyrma sp." in his collection. This specimen was taken at Rangel. Forel records this same variety from Haiti (Mitth. naturk. mus. Hamb., 1907, **24**, p. 7.)

16. MONOMORIUM PHARAONIS (Linné).

Formica pharaonis Linné, Syst. nat., 1758, ed. 10, **1**, p. 580.

This cosmopolitan tramp species could hardly be lacking in Cuba. The Gundlach coll. contains a female and two worker specimens labelled no. 23, "Monomorium sp.", but without locality. I have taken specimens in the Hotel Sevilla in Havana and in a hotel in Aguada de Pasajeros.

17. MONOMORIUM FLORICOLA (Jerdon).

Atta floricola Jerdon, Madras journ. litt. sci., 1851, **17**, p. 107.

Gundlach cites this species under the name *M. poecilum* Roger from Colon and Bermeja Nueva. His collection contains a female and worker specimen (no. 149), which undoubtedly belong to the well-known tropicopolitan species of Jerdon. It is indeed very common in west central Cuba. I have taken it at Bolondron, Aguada de Pasajeros, and in various localities in the Cienaga de Zapata (Sarabanda, Rio de Hanabana, San Francisco de Morales). It nests by preference in Tillandsias and in hollow twigs, each nest containing numerous queens, sometimes as many as thirty or forty. These queens, as I have shown in a former paper (Bull. Amer. mus. nat. hist., 195, **21**, p. 88) are always apterous. The small black males, however, which are much more rarely found in the nests, have well-developed wings.

18. MONOMORIUM CINNABARI Roger.

Berl. ent. zeitschr., 1863, **7**, p. 199 ☿.

The types of this form were taken by Gundlach in the environs of Cardenas. His collection contains two cotypes (no. 154). An examination of these leads me to believe that they represent merely a variety of *floricola,* but fresh specimens from the type locality should be examined before a definite statement can be made in regard to the status of this form.

19. CARDIOCONDYLA EMERYI Forel.

Mitth. Münch. ent. ver., 1881, **5**, p. 5 ☿.

A single worker of this widely distributed form was taken by Mr. E. A. Schwarz at Cayamas. I have recorded it from various localities in Porto Rico, the Virgin Islands, and Jamaica, and Forel described it from St. Thomas. It is also known from India, Palestine, and Madagascar. Recently I have received a specimen from Miami, Florida.

20. TETRAMORIUM GUINEENSE (Fabricius).

Formica guineensis Fabr., Ent. syst., 1793, **2**, p. 357 ☿.

This is another tramp species introduced from the Old World. Gundlach says that it inhabits various localities in the island and in his note-book mentions Cardenas as one of these. His collection contains two worker and three female specimens. I took several workers in an abandoned garden at the ingenio "Armonia" near Bolondron and several fine colonies under logs in the Cienaga de Zapata near San Francisco de Morales. I have also four workers taken at Cayamas by Mr. E. A. Schwarz.

21. WASMANNIA AUROPUNCTATA (Roger).

Tetramorium? auropunctatum Roger, Berl. ent. zeitsch., 1863, **7**, p. 182 ☿ ♀ ♂.

The types of this widely distributed neotropical ant were taken by Gundlach at Mata near Baracoa in the Province Oriente. He states that it is called "santanica" by the natives. His collection contains a female and three worker cotypes (no. 321). I have received a number of workers taken near Havana by Prof. C. F. Baker.

22. Macromischa purpurata Roger.

Berl. ent. zeitschr., 1863, 7, p. 184 ☿.

This superb ant was taken by Gundlach at Santiago de Cuba and Yateras in the eastern part of the island. His collection contains a single worker cotype (no. 315).

23. Macromischa porphyritis Roger.

Berl. ent. zeitschr., 1863, 7, p. 185 ☿.

Gundlach took this species near the city of Matanzas on the cliffs at the opening of the beautiful Yumuri Valley. His collection contains two cotypes bearing the no. 228. The Poey collection also contained this species (no. 176), which should therefore be represented in the collection of the Academy of natural sciences of Philadelphia.

24. Macromischa squamifera Roger.

Berl. ent. zeitschr., 1863, 7, p. 186 ☿.

This species was taken by Gundlach at Rangel. There is a single cotype with the no. 250 in his collection.

25. Macromischa versicolor Roger.

Berl. ent. zeitschr., 1863, 7, p. 187 ☿.

Gundlach states that he found the types of this species "in the farallones near the village Nueva Gerona, on the Isla de Pinos." There is no specimen of it in his collection, and this is explained by the remark in his note-book: "se perdió por la muerte de Roger."

26. Macromischa iris Roger.

Berl. ent. zeitschr., 1863, 7, p. 188 ☿.

The types of this species were given to Gundlach by Poey without any record of locality. There is a single cotype in the Gundlach coll. bearing the no. 121. In the Poey coll. it bore the no. 318, and should be represented in the collection of the Academy of natural sciences of Philadelphia.

27. Macromischa lugens Roger.

Berl. ent. zeitschr., 1863, **7**, p. 188 ☿.

Gundlach says that he found this species in the highlands of Camoa. It is represented by a cotype (no. 69) in his collection. It bore the no. 310 in the Poey coll. and is probably to be found in the collection of the Academy of natural sciences of Philadelphia.

28. Macromischa punicans Roger.

Berl. ent. zeitschr., 1863, **7**, p. 189 ☿.

Gundlach gives as localities for this species "the farallones of Santiago de Cuba and Monte Toro in the mountains of Guantanamo" at the extreme eastern end of the island. His collection contains a single cotype (no. 314).

29. Macromischa gundlachi, sp. nov.

Worker. Length about 4 mm.

Body rather slender. Head subrectangular, somewhat longer than broad, with the eyes at the middle of its sides. Thorax, slender, broadest through the pronotum, without distinct mesoëpinotal constriction. Epinotum about twice as long as broad, with parallel sides and without spines. Petiole slender, fully three times as long as broad, pedunculate in front, broadest behind through the node, which is rounded and very low, passing gradually into the peduncle. Post-petiole campanulate, nearly twice as broad as the petiole, as broad as long, evenly rounded above. Femora strongly incrassated; tibiae and antennae slender.

Body rather shining but apparently very finely punctate; thorax above with coarse rather sinuous longitudinal rugae.

Hairs very fine, not distinctly visible.

Dark red, the whole body, including the legs and antennae with beautiful violet reflections, which are most intense along the sides of the thorax, so that the latter appears to have a broad paler band down its middle.

Described from a single specimen (no. 375) in the Gundlach coll., without precise locality.

This species resembles *M. iris* Roger in size and in the shape of the thorax but the sculpture is very different.

30. Macromischa poeyi, sp. nov.

Worker. Length fully 5 mm.

Head somewhat longer than broad, with the eyes at the middle of its sides. Whole body long and slender; thorax as broad behind as in front, feebly and rather broadly constricted in the middle. Epinotum rounded, unarmed. Petiole very long and slender, nearly six times as long as broad, with a long slender peduncle passing gradually into the very low, rounded node. Postpetiole campanulate, subtriangular from above, with straight sides, about as broad as long. Gaster small, elongate elliptical. Legs and antennae very long, the femora with their basal half thin and uniformly cylindrical, and the apical half suddenly incrassated. Tibiae slender, not clavate.

Thorax slightly opaque, very finely and densely punctate; remainder of body more shining; pronotum obliquely, meso- and epinotum longitudinally rugulose on the sides.

Hairs white, erect, and sparse, most distinct on the thorax.

Body dark red; gaster, incrassated portions of femora and the head blackish or dark brown; pronotum in front more yellowish.

Described from two specimens (no. 466) in the Gundlach collection, without precise locality.

This species resembles *M. lugens* Roger in the shape of the thorax, but the legs are very different and unlike those of any species of the genus known to me.

31. Crematogaster sanguinea Roger.

Berl. ent. zeitschr., 1863, **7**, p. 208 ☿.

The types of this species were taken by Gundlach near Cardenas. He states that it also occurs in the environs of Santiago de Cuba. There is in his collection a single cotype (no. 130) which agrees closely with Roger's description. It has the pronotum coarsely reticulate-rugose, the head, thorax, pedicel, legs, antennae, and base of the first gastric segment light red, the remainder of the gaster black. Two workers taken by Mr. E. A. Schwarz at Cayamas evidently belong to this form of the species.

32. CREMATOGASTER SANGUINEA Roger var. TORREI, var. nov.

Worker. Length 4–4.5 mm.

Differing from the preceding form in color, the gaster being entirely black and the head, thorax, pedicel, and appendages deep red, with the posterior part of the head and the middle portions of the femora and tibiae often darker or slightly infuscated. The posterior portion of the head is shining and finely and sparsely punctate.

Female (deälated). Length 7.5 mm.

Resembling the worker in color, but the mesonotum, scutellum, and pleurae are blackish. The thoracic dorsum is smooth and shining, with fine, sparse punctures; the pleurae are longitudinally rugulose. The epinotal spines are short, scarcely longer than broad at their bases and directed backward. The head is distinctly broader than long and its upper posterior surface is very finely, longitudinally striated.

Described from several workers from a single large colony taken at Aguada de Pasajeros in a dead branch and a single female taken from a hollow twig in the Cienaga de Zapata near the Rio de Hanabana. The variety is dedicated to the Cuban naturalist Dr. Carlos de la Torre y Huerta.

I find that the form which I described several years ago (Bull. Amer. mus. nat. hist., 1905, **21**, p. 94) as *C. lucayana* from the Bahamas should be regarded as a subspecies of *sanguinea.* It differs from the typical form of this species in having the thoracic sculpture much feebler and in the more brownish color of the red parts of the body and in having the antennal clubs infuscated. The base of the first gastric segment is more broadly red than in the typical *sanguinea.* The variety *etiolata* Wheeler described in the same paper has the sculpture of *lucayana* but the head, thorax, pedicel, bases of the gastric segments, and the appendages are pale yellow.

33. PHEIDOLE FALLAX Mayr.

Verh. Zool. bot. gesellsch. Wien, 1870, **20**, p. 980, 984 ♃.

The type of this species was from Cuba and was sent to Mayr by Gundlach. There are no specimens of it, however, in the Gundlach collection.

34. Pheidole cubaënsis Mayr.

Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 747 ♃ ☿.

Mayr described this species from specimens taken in Cuba by Riehl. Gundlach states that he found specimens in the environs of Cardenas. His collection contains a soldier and worker marked no. 56. I found a few colonies under stones in rather moist soil in the Cienaga de Zapata on the finca of Sr. Perez about sixteen miles from Bolondron. The upper chambers of the nests contained numerous stored seeds, so that the species is evidently a harvester. All the soldiers taken had the head dark brown, whereas the Gundlach specimen has the head red and conforms with Mayr's description. A single soldier taken by Mr. E. A. Schwarz at Cayamas agrees with those I have taken, so that these may represent a distinct variety, but without fresh specimens from Cardenas and other parts of Cuba, I hesitate to establish a new name in a genus which is already embarrassingly complex.

35. Pheidole androsana Wheeler subsp. bakeri Forel.

Ph. bakeri Forel, Ent. mitth., 1912, **1**, p. 82 ♃ ☿.

This form was described by Forel from a single soldier and worker taken by Prof. C. F. Baker at Havana. I possess four soldiers and ten workers taken by the same collector in the same locality and in all probability belonging to the same lot as the specimens described by Forel. On comparing them with the types of *Ph. androsana* from Andros Island, Bahamas, I am unable to see that they represent anything more than a well-defined subspecies of this form. The soldier of *bakeri* differs from that of *androsana* in the following characters: — the body is smaller (4.5–5 mm.), the posterior half of the head is smooth and shining, with very sparse, minute, piligerous punctures; the thorax, petiole, and postpetiole are much less heavily sculptured and more shining, as is also the gaster. The epinotal spines are stouter, the teeth on the gula larger and the lateral conules of the postpetiole somewhat longer. The color is paler, the body being reddish yellow, a little darker than the appendages, with the tip of the gaster infuscated. The worker measures 2–2.5 mm. and differs from the worker of *androsana* in having the body smoother and more shining, especially the upper surface of the head and the pronotum.

The color, including that of the mandibles, is pale yellow, with the upper surface of the head and gaster slightly infuscated. The epinotal spines are distinctly smaller.

36. PHEIDOLE MEGACEPHALA (Fabricius).

Formica megacephala Fabr., Ent. syst., 1793, **2**, p. 361.

According to Gundlach, this ant "exists in various localities in Cuba, probably introduced with merchandise or plants." In his note-book he cites Cardenas as a locality, and single soldier, worker, female, and male specimens from this locality are preserved in his collection (no. 133.) I found large colonies of this ant at Cogimar, in the Botanical Garden of Havana, at the ingenio "Maria Victoria" near Aguada de Pasajeros, and near Sarabanda, in the Cienaga de Zapata. Mr. Patricio Cardin has sent me numerous specimens of all four phases from Santiago de las Vegas and from San Juan y Martinez in the Province of Pinar del Rio. The colonies nest under stones or logs or in obscure crater nests at the bases of trees, and each contains a number of deälated queens. The workers forage in files on the trees and bushes and are very fond of attending coccids.

37. PHEIDOLE [PUNCTATISSIMA Mayr subsp. JAMAICENSIS Wheeler var. BARBOURI, var. nov.

Soldier. Length 2.5 mm.

Differing from the typical *jamaicensis* in its smaller size and in color. The head and thorax are reddish brown, the posterior portion of the former and the upper surface of the latter often slightly infuscated, the legs brownish yellow, with the femora usually infuscated in the middle, the gaster dark brown or blackish with the bases of the segments reddish. The posterior corners of the head are opaque and densely punctate.

Worker. Length 1.5 mm.

Closely resembling the worker of *jamaicensis* in color and sculpture and even in having the antennal clubs infuscated.

Described from numerous specimens taken from several large colonies nesting under the bark of old logs in rather damp soil on the banks of the Rio de Hanabana, in the Cienaga de Zapata.

38. Pheidole flavens Roger.

Berl. ent. zeitschr., 1863 **7**, p. 198, ♃ ☿.

The types of this species, according to Gundlach, were taken in Cogimar, near Havana. His collection contains two female, one soldier, and two worker cotypes, bearing the no. 289. I have taken this species in the type locality and also in several localities in the Cienaga de Zapata (Rio de Hanabana, Sarabanda, and San Francisco de Morales) and in Mr. Sanborn's garden at the ingenio "Armonia," near Bolondron. There is a worker specimen in my collection from Cayamas (E. A. Schwarz).

39. Solenopsis geminata (Fabricius).

Atta geminata Fabr., Syst. Piez., 1804, p. 423 ♀.

According to Gundlach, this ant occurs in many localities in the island and is known as "hormiga brava" on account of its sting. In his note-book he cites it from Cardenas, Havana, and Casilda. There are in the collection five workers, one female, and a male bearing the no. 132. I found this ant more or less abundant in all of the localities I visited (Cogimar, Aguada de Pasajeros, Bolondron, Cienaga de Zapata) and have received specimens from Galatre in the Province of Pinar del Rio (T. E. Holloway and G. N. Wolcott), Havana (C. F. Baker), and Baracoa (Aug. Busck). All of the specimens I have examined belong to the typical dark form of the species. It seems to be very common in the sugar plantations. In the fields of the ingenio "Maria Victoria" near Aguada de Pasajeros it was seen in great numbers attending large coccids which were evidently very injurious to the cane.

40. Solenopsis globularia (F. Smith) var. cubaënsis, var. nov.

Worker. Closely resembling the var. *borinquenensis* Wheeler from Porto Rico, but even darker in color, the body being black, with the ventral portions of the head, thorax, and pedicel, the clypeus, mandibles, and anterior border of the head, the antennae, legs, sutures of the thorax, and apical margins of the gastric segments brownish yellow. The postpetiole is distinctly smaller and less transverse than in the typical *globularia* and its vars. *lucayana* Wheeler and *borinquenensis*.

Described from several workers taken from two colonies living under stones, one at Cogimar, the other near San Francisco de Morales in the Cienaga de Zapata.

This ant was known to Gundlach, as I find among his unidentified specimens a male and two workers with the no. 319, but without a locality.

41. SOLENOPSIS CORTICALIS Forel var. VIRGULA Forel.

Ann. Soc. ent. Belg., 1904, **48**, p. 172 ☿.

The Gundlach collection contains a few specimens (no. 83) which I refer to this variety. They bear no locality. The variety was originally described from Cuba by Forel.

42. ATTA INSULARIS Guérin.

Iconogr. régn. anim., 1845, **7**, p. 422 ☿.

Gundlach gives a good account of the habits of this, the largest and most destructive of the Cuban ants, which he calls *A. cephalotes*, and states that it occurs in both the eastern and western portions of the island. His collection contains one male, one female, and six worker specimens (no. 151).

I have seen it in the following localities:— Cogimar, Bolondron, and Aguada de Pasajeros and have in my collection specimens from Guines and Cayamas (E. A. Schwarz), El Guama, Pinar del Rio, and Guanajay (Palmer and Riley), Baracoa (Aug. Busck), and Santiago de las Vegas (M. T. Cook and C. F. Baker), Holguin, and Puerto de Golpe in Pinar del Rio (P. J. Schmitt). It is known also to occur in the Isla de Pinos.[1]

In the vicinity of Aguada de Pasajeros, both in the sugar cane fields and in the potreros, very large nests of this leaf-cutting ant may be seen. These nests are, in fact, conspicuous objects in the landscape, being great mounds twenty to forty feet in diameter and three to six feet high. The planters and gardeners wage an incessant warfare with this insect.

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[1] See Wheeler, H. E., A collector in western Cuba and the Isle of Pines. *Nautilus*, 1913, **26**, p. 113. This author erroneously calls the species *Atta cephalotes*.

43. ATTA (ACROMYRMEX) OCTOSPINOSA (Reich).

Formica octospinosa Reich, Mag. d. thierr., 1793, **1**, p. 132 ☿.

This ant is cited as *A. hystrix* by Gundlach, who found it at Cogimar and at the Coliseo railway station. His collection contains two workers with the no. 146. I found it to be common in the coppice growth at Cogimar, but did not see it in other localities. It has probably been introduced into Cuba with merchandise from South America or Trinidad.

44. ATTA (MYCOCEPURUS) SMITHI Forel var. BORINQUENENSIS Wheeler.

Bull. Amer. mus. nat. hist., 1907, **23**, p. 718 ☿.

A number of workers taken from two colonies in the garden of the ingenio "Armonia" near Bolondron, agree very closely with this Porto Rican variety, though they lack the dark spot on the vertex. They have the pair of median occipital tubercles as large as those on the posterior corners of the head. The colonies were nesting in small crater nests one to one and one half inches in diameter, with central opening, in the deep shade of a sapodilla tree. One of the nests was excavated and on returning to it the following morning I found that the workers were moving in single file to a new crater which they had excavated during the night and were carrying bits of their garden with the fungus which they cultivate and on which they feed. As I have shown in a former paper (The fungus-growing ants of North America. Bull. Amer. mus. nat. hist., 1907, **23**, p. 774), *M. smithi* grows a peculiar fungus like that of *Cyphomyrmex rimosus* and unlike that of the typical Atta and its subgenera Acromyrmex and Moellerius, on a substratum of caterpillar excrement.

45. CYPHOMYRMEX RIMOSUS Spinola var. MINUTUS Mayr.

Cyphomyrmex minutus Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 691 ☿.

Gundlach cites the name of this ant as *Cataulacus deformis* F. Smith and took it at Cogimar and Cimarrones. His collection contains single male, female, and worker specimens (no. 2). A few colonies were found near a cave about three miles from Bolondron and at Aguada de Pasajeros. They were under stones. Only traces of the fungus gardens were seen, and the ants were very inactive, probably owing to the drought. Some of the nests, however, contained males and winged females.

46. CRYPTOCERUS VARIANS F. Smith.

Trans. Ent. soc. London, 1876, p. 606, ☿.

This ant is cited by Gundlach as *C. discocephalus* F. Smith. He says that "it lives in the mountains in the western part of the island." His collection contains a female and soldier with the no. 188, from Vuelta Abajo, two workers with the no. 131, and a single worker with the no. 189. No localities are cited for these two numbers in the "Catalogo Numerico."

47. STRUMIGENYS GUNDLACHI Roger.

Pyramica gundlachi Roger, Berl. ent. zeitschr., 1862, **6**, p. 253 ☿ (*nec* ♀).

Gundlach found this species under dead bark at Cogimar or in the vicinity of Cardenas. This ambiguity is due to the fact that two species were described by Roger under this name (*vide infra*). The single worker specimen (no. 135) in the Gundlach collection is a cotype of the true *gundlachi*.

48. STRUMIGENYS ROGERI Emery.

Bull. Soc. ent. Ital., 1890, **22**, p. 31, pl. 7, fig. 6 ☿.

The types of this species are from St. Thomas, but Emery believes that the specimen described by Roger as the female of his *Pyramica gundlachi* belongs to this species. It is not represented in the Gundlach collection.

49. STRUMIGENYS ALBERTI Forel.

Trans. Ent. soc. London, 1893, p. 380 ☿ ♀.

A small colony of this ant, originally described from St. Vincent, was found under a stone in a moist spot in the Cienaga de Zapata about fifteen miles from Bolondron. The species is represented by a dark variety, *nigrescens* Wheeler, in Jamaica.

50. Epitritus emmae Emery.

Bull. Soc. ent. Ital., 1890, **22**, p. 70, pl. 8, fig. 6 ☿.

There is in my collection a winged female of this rare ant taken near Havana by Prof. C. F. Baker.

DOLICHODERINAE.

51. Iridomyrmex pruinosus (Roger).

Tapinoma pruinosum Roger, Berl. ent. zeitschr., 1863, **7**, p. 165 ☿.

The types of this species were taken at Cogimar, according to Gundlach. His collection contains two cotypes (no. 287). I have taken numerous specimens in the type locality and also at various other places (Bolondron, Aguada de Pasajeros, and at various spots in the Cienaga de Zapata (Sarabanda, Rio de Hanabana, and San Francisco de Morales). An examination of these specimens shows that the form differs only in its smaller size and dark color from *Iridomyrmex analis* Ern. André, which was originally described from Mexico but is common throughout the Southern States. This form is, therefore, to be regarded merely as a variety of *pruinosum* as Emery formerly surmised.[1] The connection between the two forms is established by a series of worker, female, and male specimens recently sent me by J. C. Bradley from Billy's Island in the Okefenokee Swamp of Georgia. The workers of this series are larger than those of the typical Cuban form but of the same form, color, and pilosity, while the females are colored like those of *I. analis*. *I. pruinosus* is also common in the Bahamas and in tropical Florida. It nests under stones or in small craters in the soil, and its workers forage in the hot sun in dense files.

52. Iridomyrmex pruinosus (Roger) var. analis (Ern. André).

Tapinoma anale Ern. André, Rev. ent., 1893, p. 148 ☿.

Prof. C. F. Baker sent me three workers from Havana, which agree perfectly in size and coloration with the forms from Mexico, Texas, Arizona, etc.

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[1] In his recent account of the Dolichoderinae in the "Genera Insectorum" 1912, p. 26, however, he cites the form as "*I. analis* var. *pruinosa*," thus reversing the true relation of the forms.

53. TAPINOMA MELANOCEPHALUM (Fabricius).

Formica melanocephala Fabr., Ent. syst., 1793, **2**, p. 353 ☿.

Gundlach, who cites this tropicopolitan ant as *Micromyrma melanocephala,* gives Cogimar as a locality. He states that "it is often found in houses and is known as 'hormiga boticaria'." There is a single worker (no. 286) in his collection. It was seen in all the localities which I visited (Cogimar, Havana, Aguada de Pasajeros, Bolondron, Sarabanda, etc.), and Mr. Patricio Cardin has sent me specimens from Santiago de las Vegas. It frequently nests in small hollow twigs or between the leaves of Tillandsias. The Cuban name "hormiga boticaria" probably refers to the peculiar "Tapinoma odor" of crushed specimens.

54. TAPINOMA LITORALE Wheeler var. CUBAËNSIS, var. nov.

The worker differs from that of the typical *litorale* of tropical Florida and the Bahamas only in having longer antennae, the scapes reaching about twice their diameter beyond the posterior corners of the head, with the basal funicular joints slightly longer than broad. In the female the upper surface of the body is uniformly dark brown, darker than in the female of the typical form and not variegated with yellow. The posterior borders of the gastric segments are only narrowly yellow and the body is slightly more pubescent and therefore more opaque. The male has the head and gaster black and the thorax dark brown, so that this sex is also much darker than the corresponding sex of *litorale.*

I have taken several colonies of this variety in hollow twigs along the banks of the Rio de Hanabana and about fifteen miles from Bolondron, also in the Cienaga de Zapata. There is a single worker from Cayamas (E. A. Schwarz) in my collection. The workers of a single colony taken in a Tillandsia at Aguada de Pasajeros are distinctly larger, but can hardly be supposed to represent a distinct variety, since the workers of Tapinoma often vary considerably in size in different colonies of the same species (*T. sessile erraticum,* etc.)

55. DORYMYRMEX PYRAMICUS (Roger).

Prenolepis pyramica Roger, Berl. ent. zeitschr., 1863, **7**, p. 160 ☿.

Several workers of the typical brown form of this species have been received from Mr. Patricio Cardin, who took them in Santiago de las Vegas, near Havana, "living associated with the Cuban turtle-back scale (Lecanium sp.)."

56. DORYMYRMEX PYRAMICUS Roger var. NIGER Pergande.

Proc. Cal. acad. sci., 1895, ser. 2, **5**, p. 871 ☿.

It is strange that this ant is not mentioned by Gundlach since it is very common in Cuba, especially in the cane lands in the southern portions of the Provinces of Havana, Matanzas, and Santa Clara. I have seen it at Cogimar, Havana, Aguada de Pasajeros, Bolondron, and in many places in the Cienaga de Zapata, and have examined a number of specimens from Cayamas (E. A. Schwarz).

CAMPONOTINAE.

57. PLAGIOLEPIS FLAVIDULA Roger.

Berl. entom. zeitschr., 1863, **7**, p. 162 ☿.

Concerning this ant Gundlach says: — "Roger found this species among those of my collection, and thus I do not know where I collected it. I do not possess it now." This accounts for its absence from his collection. The species is very puzzling, because it has never been seen since Roger described it, because the genus Plagiolepis is peculiar to the Old World, and because the brief description will apply to *Tapinoma litorale.* That Roger did occasionally confound the Dolichoderinae and smaller Camponotinae is shown by the fact that he originally described *Dorymyrmex pyramicus* as *Prenolepis pyramica.*

58. PRENOLEPIS (NYLANDERIA) LONGICORNIS (Latreille).

Formica longicornis Latr., Hist. nat. fourmis, 1802, p. 113 ☿.

Gundlach gives no precise locality for this widely distributed "tramp" species. He says: — "I have observed it in various localities in this island. It is very common and known under the name "hormiga loca" [crazy ant], because it runs very rapidly, changing its direction every moment." His collection contains two female, one male, and five worker specimens (no. 226). I found the species common in all the localities I visited: — Cogimar, Havana, Aguada de Pasajeros, Bolondron and in various places in the Cienaga de Zapata, both in houses and nesting under stones and logs out of doors. I have also several specimens taken by Mr. E. A. Schwarz at Cayamas.

59. PRENOLEPIS (NYLANDERIA) FULVA Mayr.

Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 698 ☿ ♀.

Gundlach did not recall the precise locality in which he took this species, but states that it was in the western part of the island. His collection contains a single worker (no. 192). I found the species very common in the Botanical Garden in Havana, where it was running up and down the tree trunks. It was not seen in any of the other localities which I visited.

60. PRENOLEPIS (NYLANDERIA) FULVA Mayr var. FUMATA Forel.

Deutsch. ent. zeitschr., 1909, p. 264 ☿.

Numerous workers of this variety, which is merely a smaller and decidedly darker form than the type, were taken in the Botanical Garden in Havana running about on the plants.

61. PRENOLEPIS (NYLANDERIA) VIVIDULA Nylander.

Acta Soc. sci. Fennica, 1846, **2**, p. 900 ☿ ♀ ♂.

Mr. E. A. Schwarz has taken at Cayamas two workers which I believe belong to the typical form of this species.

62. PRENOLEPIS (NYLANDERIA) VIVIDULA Nylander var. ANTILLANA Forel.

P. guatemalensis subsp. *antillana* Forel, Trans. Ent. soc. London, 1893, p. 340 ☿ ♀ ♂.

I possess three workers of this variety which were taken by Prof. C. F. Baker in Havana.

63. Prenolepis (Nylanderia) steinheili Forel.

Trans. Ent. soc. London, 1893, p. 342 ☿.

This species is common under logs and stones at some points in the Cienaga de Zapata, especially along the banks of the Rio de Hanabana.

64. Prenolepis (Nylanderia) steinheili Forel var. minuta Forel.

Trans. Ent. soc. London, 1893, p. 343, ☿ ♀ ♂.

I collected several workers of this form from a small nest under a stone at Aguada de Pasajeros. Emery described a var. *minuta* of *Prenolepis imparis* Say in the same year (1893), but I am not sure which of these varietal names should be changed. Probably Forel's name will have to be abandoned, because his paper appeared in December and Emery's was presumably of earlier date.

65. Prenolepis (Nylanderia) anthracina Roger.

Berl. ent. zeitschr., 1863, **7**, p. 161 ☿.

Gundlach observed this species in Guanabo. His collection contains two worker, two female, and two male cotypes (no. 288), but I was unable to make a careful examination of them. They looked much like specimens of *P. steinheili.*

66. Prenolepis gibberosa Roger.

Berl. ent. zeitschr., 1863, **7**, p. 161 ☿.

Gundlach collected this species in various parts of the island. In his note-book he mentions Rangel, Santiago de Cuba, and Bayamo. His collection contains only a single specimen (no. 320). This I could not examine carefully, but it looked like a specimen of *P. fulva* Mayr. Roger's description, however, shows that he could not have based the species on such a specimen, because he notes the absence of erect hairs on the antennal scapes. He probably had before him some species of Iridomyrmex allied to *I. despertitus* Forel or *melleus* Wheeler. This would be only another instance of his describing a Dolichoderine ant as a Camponotine.

67. MYRMELACHISTA KRAATZI Roger.

Berl. ent. zeitschr., 1863, **7**, p. 163 ☿.

Gundlach says that this species was taken near Cardenas. There are no specimens in his collection and his note-book contains the phrase:— "se perdió por la muerte de Roger."

68. MYRMELACHISTA ROGERI Ern. André.

Rev. ent. 1887, **6**, p. 288 ☿.

This species, which has never been taken since it was described by André, seems to be very similar to *M. kraatzi,* but differs in its darker color and the shape of the petiole which, to judge from the descriptions, is inclined forward and less compressed anteroposteriorly. The locality given by André is simply "Cuba."

69. CAMPONOTUS SANTOSI Forel.

Verh. Zool. bot. gesellsch. Wien, 1908, **58**, p. 408 ☿.

The type specimens of this species, which belongs to the *maculatus* group, were received by Forel from Dr. Santos without precise locality. I have seen two colonies of this ant, one under a stone in a cane-field at the ingenio "Armonia" near Bolondron, and another nesting in a rotten stump in the Cienaga de Zapata about fifteen miles from that town. I have also several workers taken by Prof. C. F. Baker at Cayamas and a few taken by Prof. C. H. Eigenmann in the province of Havana. I find in my collection also some workers among the material taken by myself several years ago at West Bay, in the island of New Providence, Bahamas. All of these specimens agree closely with cotypes received from Professor Forel. There is also a major worker in the Gundlach collection without number or locality. A deälated female taken from the colony at Bolondron measures 10 mm. and closely resembles the major worker. The head, however, is proportionally narrower and with more nearly parallel sides; the middle of the pronotum, the paraptera, wing-insertions, epinotal declivity, and the petiole are yellow, the first gastric segment has a yellow crescent on its anterior border and the second and third segments each have a large anterior yellow band, narrow in the middle and much broader on the sides.

70. Camponotus inaequalis Roger.

Berl. ent. zeitschr., 1863, **7**, p. 147 ☿.

Gundlach states that this species is common throughout the island. His collection contains a male, a female, and five workers, four major and one minor (no. 127). I was surprised to find on examining these cotypes that they belong to the form which I described in a former paper as *C. zonatus* Emery var. *eburneus* from the Bahamas and not to the species which I referred to *inaequalis* (var. *ramulorum*) in the same publication. On rereading Roger's description after examining the cotypes, I am of the opinion that this author had before him a series of both species and that he described the worker minor from a specimen of this phase belonging to *ramulorum* and the worker media and major and the female from specimens corresponding to my *eburneus*. It seems best therefore to relegate this last form and possibly also Emery's *zonatus* to the synonymy of *inaequalis* and to regard *ramulorum* as a distinct species. It is not impossible that Roger's series may also have included immature specimens of Forel's *santosi* as this and the two other species are all closely related and highly variable in color and may have been readily confounded by Gundlach. I have not myself taken specimens of *C. inaequalis* in Cuba but have received a number of workers and females taken in Havana by Prof. C. F. Baker and Mr. F. Rose, and a few minor workers taken by Mr. Patricio Cardin at Santiago de las Vegas.

71. Camponotus ramulorum Wheeler.

Camponotus inaequalis var. *ramulorum* Wheeler, Bull. Amer. mus. nat. hist., 1905, **21**, p. 114.

Several colonies containing major and minor workers indistinguishable from those which I took in the Bahamas were found in hollow twigs of the sea-grape (*Coccoloba uvifera*) and other small trees in the coppices along the sea shore at Cogimar, near Havana.

72. Camponotus ramulorum Wheeler var. mestrei, var. nov.

This differs from the typical *ramulorum* and its variety *marcidus* Wheeler in its smaller size and in coloration. The major worker measures only 5.5–6.5 mm., the minor 3–4.5 mm. The brown color of the head, thorax, and gaster are deeper and more blackish and extend further back on the head, leaving only the posterior border and posterior corners yellow. The whole upper surface of the thorax is blackish, variegated with brown, and the transverse stripes on the gaster are more sharply outlined both in the major and minor workers. The yellow portions of the body are more whitish than in the typical *ramulorum*.

I have seen numerous specimens of this new variety, which is dedicated to Prof. Aristides Mestre of the University of Havana, from two colonies, one taken by Prof. C. H. Eigenmann at Havana (type locality) in the dead pod of a leguminous vine and one by myself in the hollow twig of a shrub at Aguada de Pasajeros.

73. Camponotus planatus Roger.

Berl. ent. zeitschr., 1863, **7**, p. 148 ☿ ♀ ♂.

Gundlach took the types of this species at Sarabanda in the Cienaga de Zapata. His collection contains two major workers, a male, and a female cotype (no. 210). I have taken the species in the same locality and also at Cogimar, Bolondron, Aguada de Pasajeros, and at all the points visited in the Cienaga. It nests in hollow branches and the workers are often found running singly on the trunks, branches and leaves of trees.

74. Camponotus sphaericus Roger.

Berl. ent. zeitschr., 1863, **7**, p. 146 ☿.

Gundlach took this species in the vicinity of Santiago de Cuba. His collection contains a single specimen (no. 316). A single worker minor taken by Mr. E. A. Schwarz at Cayamas agrees well with Roger's description, except that the body is opaque and not shining. The pronotum in nearly twice as broad as long, the white hairs on the body are pointed and the appressed ones are not flattened and squamiform and not abundant on the gaster. The mandibles, legs, and antennae are uniformly red. The specimen measures only 4.5 mm. and is therefore considerably smaller than the types which measured 6–6.5 mm. It may, perhaps, represent a distinct subspecies.

75. CAMPONOTUS SPHAERALIS Roger.

Berl. ent. zeitschr., 1863, **7**, p. 147 ☿.

Gundlach says that he could not remember where he collected this species, and as the specimens were lost on Roger's death, it is not represented in the collection.

A single worker taken by Prof. C. F. Baker at Havana agrees very closely with Roger's description. It differs from *sphaericus* in having the pronotum longer in proportion to its width and the appressed hairs, or pubescence, on the body flattened, squamiform, and more abundant, especially on the gaster. The color and shape of the body are so much like those of *sphaericus* that one is tempted to regard it merely as a subspecies, but more material will be required to establish the relationship of the two forms.

76. CAMPONOTUS GILVIVENTRIS Roger.

Berl. ent. zeitschr., 1863, **7**, p. 145 ☿.

According to Gundlach, this species lives in the mountains throughout the island. His collection contains a single cotype (no. 317).

77. CAMPONOTUS (COLOBOPSIS) RIEHLI Roger.

Berl. ent. zeitschr., 1863, **7**, p. 159 ♀.

Gundlach took this species in the western part of the island. There is a single winged cotype in his collection (no. 155).

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THE LAND MAMMALS OF NEWFOUNDLAND.

By Outram Bangs.

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No. 18.— *The Land Mammals of Newfoundland.*

By Outram Bangs.

The great island of Newfoundland lying close under the eastern corner of the Labrador peninsula is a region where the unlooked for is often found. One without previous knowledge of its biota would expect to find there all the plants and animals of the neighboring mainland, and these only slightly differentiated. Such, however, is not the case and the mammalian fauna is more remarkable for the species that are lacking than for the highly differentiated ones that it contains. The island is situated too far north to have a large resident ornis, still many of the non migratory birds found there have become different and one by one have been separated by name from their mainland representatives. Its flora is even more remarkable and contains a number of southern, pine-barren or sand-plain types not found on the adjacent mainland.

The means by which Newfoundland has acquired its biota have been studied in the most thorough manner by the distinguished botanist, Prof. M. L. Fernald whose paper on the subject, Rhodora, July, 1911, **13**, p. 109–162, should be read with care by all interested in the distribution of life in North America.

The island attracted my attention in the early days of my work on North American mammals — it was a virgin field — and the services of Mr. Ernest Doane were secured to make collections there. During the two or three years that Mr. Doane was sending me specimens, I described the different species peculiar to the island in short papers always having in mind an extended account of the mammals for publication at some future time. This project I have now abandoned, but trust that the following notes, discussions of the different species, and nominal list of all known to occur may be useful to one who may undertake a monograph of the biota of Newfoundland, one of the larger islands of the world.

The following notes are based upon exceptionally fine material, except in the case of the bear and of the wolf. Besides the large series of specimens collected by Mr. Doane the Museum of Comparative Zoölogy has numerous skulls of the larger mammals, sent many years ago by Mr. S. M. Nelson, and a series of five Black bear skulls procured by Dr. John C. Phillips during one of his expeditions.

At present, it is idle to speculate whence Newfoundland derived its meagre mammalian fauna. Two facts, however, are perfectly clear:— 1st, that there has been no land connection between the island and the Labrador peninsula; and 2nd, that most of the indigenous mammals of Newfoundland have been there for an enormously long space of time. The first being proved by the array of genera, common in the opposite mainland, unrepresented in Newfoundland; and the second by the marked characters, cranial and otherwise, shown by most of the island species.

The following sixteen genera (and subgenera used here in the same sense) are found in the Labrador peninsula and are unknown in Newfoundland: — Condylura; Sorex; Gulo; Lutreola; Mephitis; Peromyscus; Mictomys; Dicrostonyx; Phenacomys; Evotomys; Zapus; Napaeozapus; Erethizon; Marmota; Tamiasciurus; Sciuropterus.

Full references to the names here used can be found in the List of North American land mammals in the United States national museum, 1911. By Gerrit S. Miller, Jr. Bull. **79**, U. S. nat. mus., 1912.

THE INDIGENOUS MAMMALS OF NEWFOUNDLAND.

The Black bear is not uncommon in the island, and in view of the differences the other indigenous species show, will probably prove to be an insular form. Our series of six skulls is wholly inadequate, five of them are females, and the sixth is young. Individual variation is very great in the Black bear, and a long series of skulls of old males is necessary before it can be determined whether the Newfoundland animal is separable from the mainland form.

The Wolf is now exceedingly rare in Newfoundland and I have never seen a specimen. One was killed during the time Doane was collecting, but he was unable to procure it. Another was shot about two years ago, which Dr. Phillips hoped he had secured, but in some unaccountable way it was lost to us. All who have seen the animal in life report it as being a pale colored wolf. What it is remains for some one fortunate enough to get a specimen to decide.

The Newfoundland red fox, *Vulpes deletrix* Bangs, is a well differentiated island species, very pale and yellowish in color, and with very large hind feet and claws. It is common.

The Newfoundland marten, *Martes atrata* (Bangs) is decidedly a scarce animal and is peculiar to the island. It is a rather small species of very dark colors. In other places, Pine martens appear wholly dependent upon the Red squirrel — their natural prey; I have no knowledge as to what the Marten subsists upon in Newfoundland where there *are no squirrels.* It would hardly seem possible that it could secure enough birds, or that it could catch the Vole as of course the Weasel does. The fur of the Newfoundland marten is of very fine quality and beautiful in color.

The Newfoundland weasel, *Mustela cicognanii mortigena,* sub. sp. nov.

Type, skin and skull no. 3745, ♂ adult, coll. E. A. and O. Bangs. M. C. Z. Bay St. George, Newfoundland, Sept. 27, 1895. Ernest Doane.

Characters: — Similar to *Mustela cicognanii richardsonii* (Bonaparte) of interior Boreal America — Hudson's Bay to Alaska, but color in summer pelage, deeper and richer, less yellowish brown; feet and hands with less white; tail decidedly shorter; skull and teeth similar, I cannot distinguish the skulls of the two subspecies with any certainty, size about the same. From *M. cicognanii cicognanii* Bonaparte of eastern North America, Labrador to New England, the present form differs by its much larger size, more robust skull, and heavier dentition.

Color: — Upper parts rich glossy brown, about Prout's brown. The color is a very difficult one to define by name, on account of the gloss of the fur; it is darker, less yellowish than in *M. cicognanii richardsonii,* and distinctly paler than in *M. cicognanii cicognanii.* Upper lip, and under parts yellowish white; toes, fingers, and inside of legs and arms, white; tail black tipped. *Winter pelage,* wholly yellowish white (sometimes dead white) all over, except black-tipped tail.

Measurements: — *Type,* no. 3745, adult ♂ (not old) total length, 322; tail vertebrae, 93; hind foot, 48. No. 1102 from Codroy Newfoundland old adult ♀, total length, 270; tail vertebrae, 80; hind foot, 34.

Averages of ten adult males from Newfoundland, total length, 329.6; tail vertebrae, 97.9; hind foot, 46.

Averages of four adult males of *M. cicognanii richardsonii* from Mackenzie and Athabasca, total length, 335; tail vertebrae, 104.75; hind foot, 47.

Skull, *Type* adult ♂ (not old), basal length, 45.2; occipitonasal length, 42.4; zygomatic width, 25.; mastoid width, 21.2; interorbital width, 10.4; width across postorbital processes, 12.; least width behind postorbital process, 10.8; length of palate, to end of pterygoid process, 24.8; to palatal notch, 18.; length of single half of mandible, 238.

Remarks: — The Weasel is one of the few Newfoundland mammals that undoubtedly is only a subspecies. Weasels are not at all averse to crossing large sheets of water in winter on the ice. I have heard of their being seen doing this, several times. Mr. W. S. Brooks, an excellent observer, once when standing on the shore of a large frozen lake in Alberta noticed a little object coming toward him like a black feather being blown rapidly across the smooth ice. When it reached shore he found it to be a little white weasel, that had made the passage of the lake on the ice and whose black-tipped tail alone he had seen.

In this connection, I have just been over with the greatest care, an immense series of weasels of the *cicognanii* group including a fine lot of *M. cicognanii richardsonii* some of which are from the actual type locality, kindly loaned by the Bureau of biological survey of Washington. The bulk of the specimens from the Labrador peninsula are referable to true *M. cicognanii* as are all from Lake Edward, Quebec. Some specimens from Black Bay and L'Aure au Loup, Labrador are, however, perfectly intermediate between that form and the Newfoundland weasel, and one young adult male[1] from the former place, is, so far as I can make out quite the same as *M. cicognanii mortigena.* I am therefore rather inclined to believe that there is occasionally an actual interchange of individuals between Newfoundland and the parts of Labrador nearest to it. The Weasel is very common in Newfoundland and preys upon the Vole, which occurs in unlimited numbers.

The Newfoundland otter, *Lutra degener* Bangs, is an exceedingly well characterized island species, differing in many respects, though most of all, in its weak, small skull with very slender zygoma. It is not very common, and of course is peculiar to Newfoundland.

The Newfoundland lynx, *Lynx subsolanus* Bangs was formerly exceedingly scarce, but since the introduction of the American hare has increased extraordinarily and is now abundant all over the island. Its rapid increase during the course of a few years was due solely to an abundance of the food the Lynx likes better than any other. All trappers or hunters in Newfoundland, however, disbelieve this, holding that the lynxes appeared suddenly in great numbers from some adjacent region. Comparison of skins entirely breaks down any such theory, the Newfoundland animal being very dark in color and easily recognized at a glance from continental specimens.

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[1] No. 7980 Coll. E. A. & O. Bangs, young adult ♂, skin and skull, Black Bay, Labrador. E. Doane, Sept. 22, 1898. Total length, 336; tail vert. 95; hind foot 42.

The Newfoundland vole, *Microtus terraenovae* (Bangs), has the distinction of being the only indigenous small mammal of Newfoundland. It is also a fine species, wholly unlike any of the voles of the Labrador peninsula, and, if such resemblances do not deceive us by what Maynard calls the "law of cyclic recession," is more like the vole of the sandy coasts and islands of southeastern Massachusetts, which is a slightly modified form of *M. pennsylvanicus pennsylvanicus* (Ord.) It is abundant throughout the island.

The Newfoundland muskrat, *Fiber*[1] *obscurus* Bangs, is another of the very distinct species, peculiar to the island, differing from all other muskrats in both external and cranial characters. It is very common and found in the island wherever there is water.

The Newfoundland beaver, *Castor caecator*, sp. nov.[2]

Type, skull no. 6979 adult ♂, Coll. E. A. and O. Bangs, M. C. Z. Near Bay St. George, Newfoundland in 1896. Ernest Doane.

Characters: — Similar to *Castor canadensis* Kuhl, but slightly smaller, and differing in the following marked cranial characters:— interparietal very much wider, more roundish in shape; zygoma much lighter, much less flaring — the outer side of the arch, much straighter, less bowed outward, giving a *much more* triangular appearance to the skull when viewed from above; nasals shorter and wider; dentition about the same. In all skulls I have examined the upper incisors in *C. canadensis* are orange and in *C. caecator* yellow.

Measurements: — Type skull, basal length, 133.4; occipitonasal length, 131.; zygomatic width, 90.4; interorbital width, 24.; length of palate to end of pterygoid, 96.8; to palatal notch, 74.; length of nasals, 47.4; width of nasals, 23.2; length of single half of mandible, 103.

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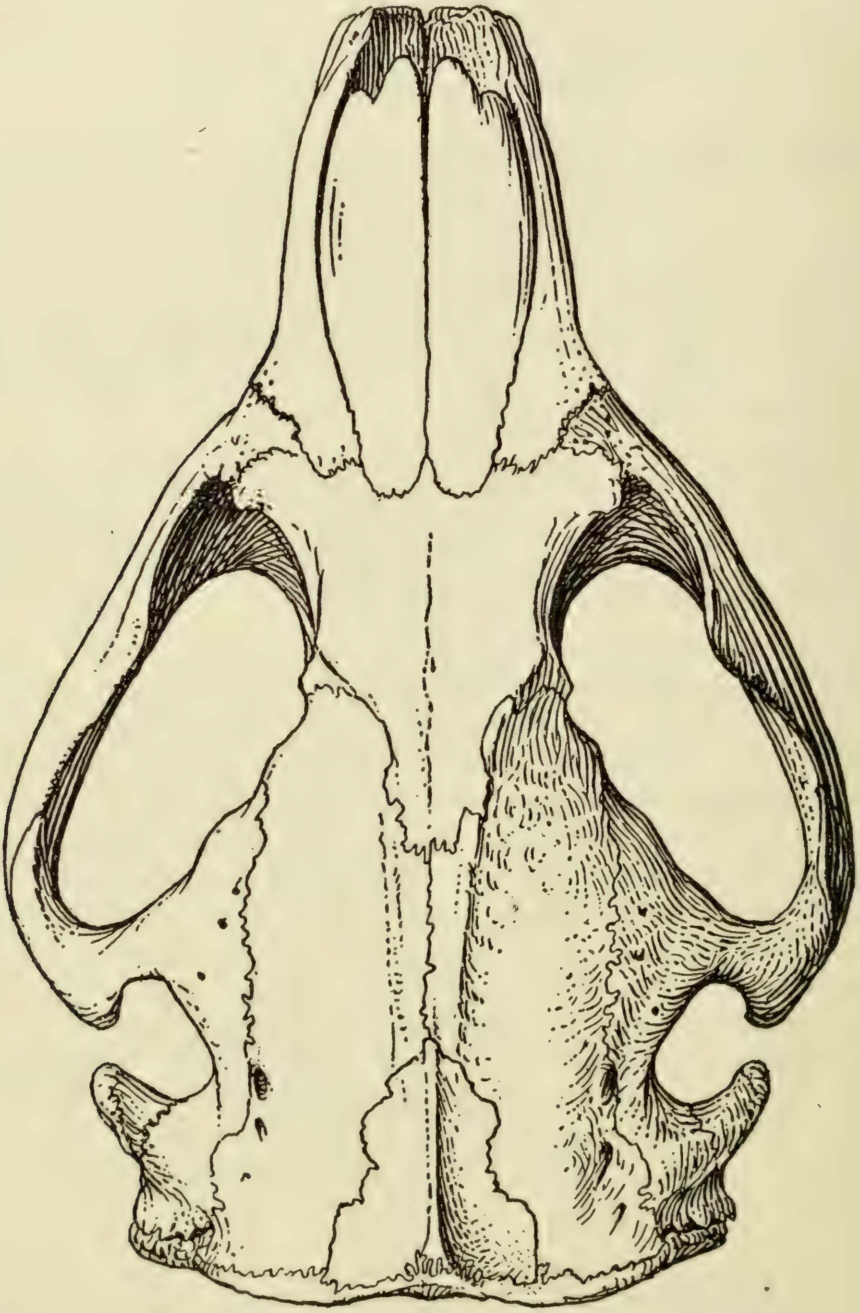
[1] There appears still to be difference of opinion as to whether *Fiber* or *Ondatra* is the generic name of the muskrat. I therefore use the former.

[2] *Caeco*, to make blind, hence *caecator*, he who stops or obstructs a fountain.

Remarks: — Some years ago, I examined in the flesh two beavers from Newfoundland. There was nothing distinctive in the external appearance of these beaver, though they were rather small, and of exceptionally fine rich color. In cranial characters, however, the



Castor caecator Bangs.

Newfoundland beaver is perfectly distinct, and skulls can be distinguished at once by either of two characteristics — the differently shaped zygoma which give to the skull a triangular appearance, or the very large and very roundish interparietal, both characters showing in young as well as in adult skulls. The nasals are also different in shape. The Newfoundland beaver, though much trapped for its fur, still occurs in fair numbers in the remoter parts of the island.

The Arctic hare, *Lepus arcticus bangsii* Rhoads that occurs in Newfoundland is probably not confined to that island but ranges over the adjacent parts of the Labrador peninsula north to Hamilton Inlet. It is now very rare and local in Newfoundland, occurring only on the tops of some of the higher mountains. Ever since the advent of the American hare the native species has steadily decreased in numbers, and it is now found only in places not frequented by *L. americanus struthopus.*

The Newfoundland caribou, *Rangifer terraenovae* Bangs, is a fine island species peculiar to Newfoundland. It is still common, and can be seen, especially during its migration, in very large bands. I am informed by sportsmen, that during the last decade or so big heads — such as my type — have become rare.

Nominal List of the Mammals of Newfoundland.

Myotis lucifugus lucifugus (Le Conte).
Not uncommon in summer.
Ursus americanus americanus Pallas.
Resident, not uncommon.
Thalarctos labradorensis Knottnerus-Meyer.
Occasionally reaches the island on ice floes; not resident.
Canis lycaon Schreber.
Now very rare, perhaps nearly extinct in Newfoundland.
Alopex lagopus ungava (Merriam).
Now and then the Arctic fox reaches Newfoundland in the same manner as the Polar bear; not resident.
Vulpes deletrix Bangs.
Peculiar to Newfoundland.
Martes atrata (Bangs).
Peculiar to Newfoundland.

Mustela cicognanii mortigena Bangs.

Newfoundland and adjacent parts of the Labrador peninsula.

Lutra degener Bangs.

Peculiar to Newfoundland.

Lynx subsolanus Bangs.

Peculiar to Newfoundland.

Phoca vitulina Linné.

Very common about the coasts.

Phoca hispida Schreber.

Common along the coasts.

Phoca groenlandica Erxleben.

Common along the coasts.

Erignathus barbatus barbatus (Erxleben).

Not so common as some of the other seals.

Halichoerus grypus (Fabricus).

A rather uncommon seal.

Cystophora cristata (Erxleben).

Not common on the coasts of Newfoundland.

Odobenus rosmarus (Linné).

Formerly the Walrus undoubtedly reached south to Newfoundland, but it is now many years since it occurred there.

Microtus terraenovae (Bangs).

Peculiar to Newfoundland.

Fiber obscurus Bangs.

Peculiar to Newfoundland.

Epimys norvegicus (Erxleben).

Introduced and abundant.

Mus musculus musculus Linné.

Introduced; not so abundant as the Rat.

Castor caecator Bangs.

Peculiar to Newfoundland.

Lepus arcticus bangsii Rhoads.

Newfoundland and probably adjacent parts of the Labrador peninsula.

Lepus americanus struthopus Bangs.

Introduced; now very abundant.

Alces americanus Jardine.

Introduced but not successfully naturalized; said still to be found in very small numbers.

Rangifer terraenovae Bangs.

Peculiar to Newfoundland.

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
VOL. LIV. No. 19.

PRELIMINARY DESCRIPTIONS OF TWO NEW FORMS OF PERIPATUS FROM HAITI.

BY CHARLES T. BRUES.

CAMBRIDGE, MASS., U. S. A.,
PRINTED FOR THE MUSEUM.
AUGUST, 1913.

No. 19.— *Preliminary Descriptions of two New Forms of Peripatus from Haiti.*[1]

By Charles T. Brues.

The present brief communication includes preliminary descriptions of one new species and one new subspecies of Peripatus which were obtained by Mr. W. M. Mann on the island of Haiti during a recent collecting trip made by him into the Republic of Haiti which occupies the western part of this West Indian island. He secured two specimens of this interesting genus, each representing a different form. One, which is described as a new species, is closely related to a species from the Caribbean coast of South America, while the second appears sufficiently close to *Peripatus dominicae* to rank as a subspecies of the latter.

It is impossible to make a complete study of these specimens at the present time but the extreme interest of any information relating to the geographical distribution of these animals, particularly in Haiti, has made an early account of the present material appear advisable.

Peripatus dominicae Pollard.

subsp. haitiensis, subsp. nov.

Type. M. C. Z. 195. Haiti: near Furcy. February, 1913. W. M. Mann.

♀. Resembles *Peripatus dominicae* var. *juanensis* Bouvier quite closely, but the large primary papillae are more approximate and although frequently separated from one another by smaller papillae, quite generally appear in pairs with a single small papilla interpolated between the pairs of large ones. Many of the smaller papillae also tend to approach the sides rather than the ridge of the tegumentary folds.

Form and dimensions. The type measures 45 mm. in length and is rather slender for members of this group. Thirty-one pairs of legs; the nephridial tubercles of the fifth pairs of legs not attached to the creeping pads, although both adjacent pads are deeply emarginate at this point.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 68.

Integument. The folds number twelve to each segment dorsally, but the hyaline lines between them are broken frequently to include a small or medium-sized papilla which is placed directly in a lanceolate, island-shaped spot in the position of the inter-rugal furrows. The primary papillae are always inserted close to the center of the folds and are usually very well differentiated from the accessory ones which are very small and placed on the sides of the folds. The papillae of intermediate size are placed near the center of the folds, but not so regularly as the large ones and are often situated halfway to the margin; they do not appear regularly between each pair of large papillae as two or even three or more large ones commonly occur in continuous series. The large primary papillae have a rather uniform large circular base and taper evenly to a rounded tip.

Coloration. The color in life is uniform dark purple.

Type locality. Furcy, Haiti. Beneath a pine log in a little hollow below the trail along the ridge, about one mile from the chapel.

Mr. Mann, who observed the color of the living animal, adds that it "was living two hours after capture, when it was fixed."

PERIPATUS MANNI, sp. nov.

TYPE. M. C. Z. 196. Haiti: near Furcy. November, 1912. W. M. Mann.

♀. Resembles *Peripatus sedgwicki* Bouvier, but the number of the smaller primary papillae is even less than in that species. The large primary papillae are widely separated as in *sedgwicki* and the accessory papillae extremely reduced in the same way. The color is totally different from that of *sedgwicki* or any other Caribbean species as the body is dark purple, with a bright orange spot on each side of the head.

Form and dimensions. The type, which is evidently not completely grown, is slender, 17 mm. in length. There are thirty-one pairs of legs of the usual form for the group.

Integument. The folds number twelve to each segment and are of very regular width on the dorsum. The furrows between the folds are extremely well marked, being wider than usual, which results in making the elevated portions unusually narrow. The large primary papillae are set very far apart along the ridge of each fold with a smaller papilla usually, but not always, placed between adjacent larger ones. The large papillae do not form distinct lines parallel with the longitudinal axis of the body except for a line on each side of the median dorsal line. On each side of the median line is an even series of large papillae, so that there is a narrow dorsal longitudinal band along the body which is devoid of papillae. The larger primary papillae have a small cylindrical base, with the apical portion much enlarged, while the smaller ones are short and but little enlarged apically. The accessory papillae are extraordinarily small.

Coloration. The color in life as observed by Mr. Mann is dark purple, almost black, with an orange spot on either side of the head.

Type locality. Furcy, Haiti. Mr. Mann has also furnished the following notes on the habitat of the single specimen: — "Taken beneath a stone, in red clay soil, on the trail leading to Furcy, about a mile and a half from the settlement. The altitude of Furcy is given at 1500 and 1730 metres by different authorities, and this location is about 30 metres lower. Beneath the same stone were numerous phalangids and centipedes. The individual was very delicate, dying a few moments after being placed in the collecting box".

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A REVISION OF THE AMERICAN SPECIES OF CERAURUS.

By Percy E. Raymond and Donald C. Barton.

With Two Plates.

CAMBRIDGE, MASS., U. S. A.,
PRINTED FOR THE MUSEUM.
November, 1913.

No. 20.— *A Revision of the American Species of Ceraurus.*

By Percy E. Raymond and Donald C. Barton.

The genus Ceraurus was proposed in 1832 by Green for a new trilobite which he described as *Ceraurus pleurexanthemus.*[1] The genus has been accepted and used by American palaeontologists, with the notable exception of Billings, and by a few European writers, among whom were Roemer and Eichwald. The younger name Cheirurus, proposed by Beyrich in 1845,[2] has, however, been preferred by nearly all European palaeontologists. The description of this genus was accompanied by the diagnoses of four species, *Cheirurus insignis* Beyrich, *Ch. claviger* Beyrich, *Trilobites sternbergi* Boeck, and *Ch. gibbus* Beyrich, and it is evident from the text that Beyrich had other unnamed species in hand at the time. Of the four named species in this article, *Cheirurus claviger* is the type of Corda's genus Eccoptochile, and *Ch. sternbergi* and *Ch. gibbus* are species of Salter's Crotalocephalus. This leaves only the first species, *Ch. insignis,* to serve as the type of Cheirurus, and it is evident from the description that Beyrich based his genus almost entirely on this species. Beyrich was familiar with Green's description of Ceraurus, but felt that the description and figure of that genus were so poor as to prevent its recognition. Later, when Green's genus became better known through Hall's figures, Beyrich's genus had become so familiar to European palaeontologists that it retained their preference. The two genera have been considered as essentially synonymous. We, however, believe that this is not the case, and shall attempt to show that Ceraurus and Cheirurus are distinct, although closely allied, genera.

The genus Cheirurus, although originally used so broadly as to include most of the Cheirurinae, has been restricted by the erection of genera and subgenera, such as Eccoptochile and Actinopeltis Corda, Cyrtometopus and Sphaerocoryphe Angelin. Finally it was restricted by Schmidt[3] to those cheirurids in which there are always eleven segments in the thorax, the inner part of each pleuron is cut by a diagonal furrow, the glabella expands forward, and the lateral furrows of the glabella are always distinct. Reed [1] follows Schmidt in this restriction of Cheirurus, but goes further and separates Salter's subgenus Crotalocephalus from the group which was included in Cheirurus by Schmidt. Reed divided Cheirurus as restricted by him into two groups, the first with what he designated as the cyrtometopian pygdium (essentially like that of Ceraurus), and the second with the *Cheirurus insignis* type of pygidium, that is, with three pairs of subequal pleural spines, and a short median spine. When the characteristics of these two groups are studied, it is found that they differ in the structure of the head as well as of the pygidium. In the second group the posterior pair of glabellar furrows are nearly or quite straight, slope backward at a considerable angle, and open directly into the neck-furrow at or near the middle of the glabella. The basal lobes thus cut off are triangular, and their inner ends almost meet. In this same group the surface of the glabella is smooth, and while the cheeks may be pitted, they are not pustulose. It is further noticeable that the glabella is large in this group, usually occupying one third or more of the width of the cephalon. In the first group, with crytometopian pygidium, the glabella is usually (in the American species always) pustulose, and the glabella is usually less than one third the total width of the cephalon. The posterior glabellar furrows are short, each extending only about one third the distance across the glabella, and instead of connecting with the neck-furrow, their course is approximately parallel to it. There is, however, usually a secondary constriction parallel to the long axis of the glabella, which connects the inner end of the furrow with the neck-furrow. This constriction may be very faint or very deep. In the latter case the posterior glabellar lobes are completely isolated, are nearly square in outline, and are separated from each other by a portion of the glabella whose width is about equal to that of one of the posterior lobes. All of the known species of the first group are found in strata of Ordovician age, while those of the second occur in the upper Ordovician (Bohemia only, so far as known) and Silurian. In geographical distribution, only the first group is found in Russia, and it preponderates in Scandinavia. The home of the second group is in Bohemia, but it is also more prominent than the first group in Great Britain. Both groups are present in North America.

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[1] Monograph of the trilobites of North America, 1832, p. 83.

[2] Ueber einige Bohmischen trilobiten. Berlin, 1845, p. 5.

[3] Revision der Oestbaltischen Silurischen trilobiten. Mem. Acad. imp. sci. St. Petersburg, 1881, ser. 7, **30**, p. 122.

The differences between these two groups are so constant and well marked that we believe the groups worthy of generic names. *Cheirurus insignis* Beyrich, has the characteristics of the second group, so that group becomes the Cheirurus in our restricted sense, while the first group is typified by *Ceraurus pleurexanthemus,* the type-species of Ceraurus. Reed cited *Cheirurus exsul* Beyrich, as the type both of the restricted genus Cheirurus, and of his subdivision of the restricted genus in which the pygidium was cyrtometopiform. This species, although described by Beyrich along with Bohemian trilobites, is a northern form, and a Ceraurus. It was not described by Beyrich in the paper in which he first described the genus Cheirurus, and it cannot be taken as the type of that genus.

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[1] Evolution of Cheirurus. Geol. mag., 1896, dec. 4, **3**, p. 117.

The genus Cheirurus, as we understand it, comprises those species of Reed's restricted genus Cheirurus which have the posterior pair of glabellar furrows nearly straight, sloping more or less rapidly backward, and opening directly into the neck-furrow at or near the axis of the glabella; whose basal glabellar lobes are triangular, and not separated by a portion of the glabella; and the pleural spines of whose pygidia are subequal in length.

TYPE.— *Cheirurus insignis* Beyrich.

The genus Ceraurus, on the other hand, comprises those species characterized by short posterior glabellar furrows which slope only gently backward and do not open directly into the neck-furrow but are connected with it by longitudinal constrictions; whose basal lobes are quadrangular, rather than triangular; whose glabella is usually more or less strongly pustulose; and the spines of whose pygidium are very unequal in length, the first pair being strongly developed, and the remainder very short or absent.

TYPE.— *Ceraurus pleurexanthemus* Green.

Key to American Species.

A. Glabella or neck-segment strongly spinose
  a. A pair of short horn-like spines on the crest of the frontal lobe *bispinosus,* sp. nov.
  b. A single median spine on the neck-segment . *numitor* Billings
B. Glabella merely pustulose or with small spines
  c. Genal angles without spines
    Glabella expanding rapidly forward.......... *misneri* Foerste
  d. Genal angles with spines
    A. Glabella expanding forward

I. Eye usually more than half the length of the cephalon from the posterior margin.
 A small form, glabellar expansion I in 4. *hudsoni* Raymond
 A medium sized form, glabellar expansion I in 7. *pleurexanthemus* Green
II. Eye usually about one half of the length of the cephalon from the posterior margin....... *milleranus* M. and G.
III. Eye less than one half the length of the cephalon from the posterior margin............... *dentatus,* sp. nov.
B. Glabella with parallel sides........... *granulosus,* sp. nov.

CERAURUS PLEUREXANTHEMUS Green.

Plate **1**, fig. 1; Plate **2**, fig. 1, 2, 7.

Ceraurus pleurexanthemus Green, Monthly Amer. journ. geol., 1832, p. 560, pl., fig. 10; Monogr. N. A. trilobites, p. 84, pl. 1, fig. 10, cast 33. Hawle & Corda, Prodr. monogr. Bohem. trilobiten, 1847, p. 161, pl. 7, fig. 82. Hall, Pal. N. Y., 1847, **1**, p. 242, pl. 65, figs. 1a-c, 1e-g (not 1d, 1h, 1i, 1m, nor pl. 66, figs. 1a-g). Emmons, Amer. geol., 1855, **1**, p. 217, pl. 15, fig. 1b-e, 1g (not 1a, 1h, 1i, 1k). Walcott, Ann. Lyc. nat. hist. N. Y., 1875, **11**, p. 155, pl. 11; Bull. M. C. Z., 1881, **8**, p. 211, pl. 5, fig. 1–6. Clarke, Pal. Minn., 1897, **3**, p. 734. Weller, Pal. N. J., 1897, **3**, p. 204, pl. 15, fig. 28.

As may be seen from the citations under this species and the next, the literature is full of references to *Ceraurus pleurexanthemus,* but original figures are scarce, most authors seeming to find Hall's imperfect illustrations satisfactory. Barrande, as early as 1852, was led by Hall's figures to believe that two species had been described under one name,[1] but up to the present no one has given the subject any especial attention. There have been two reasons for this neglect of the species. One is, that although it is common at various horizons in the Ordovician, good specimens are exceedingly rare; in the second place, the figures given by Hall are so poor that they do not afford means for fine discrimination, and encourage a quick and loose determination of the specimens.

The Walcott and Dyer collections in the Museum of Comparative Zoölogy afford abundant material for the study of the various forms which have been referred to this species, and the Geological Survey of Canada, through the courtesy of Director Brock, has loaned a considerable number of specimens.

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[1] System Silurian de la Boheme, 1852, **1**, p. 756.

The type of *Ceraurus pleurexanthemus* is well known from the plaster casts distributed by Green, and the original specimen was refigured by Hall. The cast shows a very poorly preserved trilobite, about 25 mm. long, with the greater part of both cephalon and pygidium buried in the matrix. The cephalon shows a pair of narrow flaring genal spines, and small, prominent eyes, which are nearer to the glabella than to the posterior margin of the cephalon. The greater part of the glabella and all of the anterior margin of the cephalon are concealed. On the fixed cheeks, just inside of, and behind the eye, are two small, sharp tubercles which seem to be present in all species of Ceraurus. The thorax shows 11 segments; the axial lobe is convex, prominent, a little less than one third the total width. The pleural lobes are flat to the fulcrum, where there is a line of prominent nodes. The part of each pleuron within the fulcrum is divided by a diagonal furrow into two triangular nodes. The pygidium is mostly concealed, but shows one of the long spines which characterize the genus.

A study of the numerous specimens of Ceraurus at hand has convinced us that the position of the eye is an important and constant character, and in this respect Green's type agrees with the specimens found at Trenton Falls, N. Y. The other characters, in so far as the cast shows them, are also in accord with the specimens from that locality. Trenton Falls is only about fifteen miles from Newport, which is given as the locality from which the original specimen was derived, but the strata there are somewhat higher in the Trenton than are those at Newport. However, it is not at all impossible that the original specimen may have come from Trenton Falls, as that place had been known as a locality for trilobites long before 1832. In any case, specimens from Trenton Falls may be taken as typical of the species, and the description here given is derived from specimens found there.

DESCRIPTION.— Body, disregarding spines, obovate, with flaring spines at the genal angles and on the pygidium. Axial lobe about one third the total width, convex, and tapering but slightly.

Cephalon broad, roughly semicircular in outline, about .4 as long as broad. Glabella very convex, expanding forward, and reaching the frontal margin. The expansion is slight, averaging about 1 mm. in 7. The front of the glabella is nearly square, being but slightly curved. There are three pairs of glabellar furrows; the first two pairs are short, while the third pair are stronger, and turn abruptly back to join the neck-furrow, thus isolating a pair of small, nearly square lobes at the base of the glabella. The other furrows are deep at their junction with the dorsal furrows, and thus form small, node-like side lobes. There is some variation in the course of the posterior pair of furrows. In the majority of specimens they turn back to the neck-furrow, but in a few they become very faint at the inner ends, so that the posterior lobes do not appear to be isolated. The fixed cheeks are convex, highest at the eye, and bear the genal spines. The free cheeks are small, the sutures reaching the anterior margin at points but little behind the eyes. A facial suture leaves the anterior margin where each dorsal furrow intersects it and runs outward and backward on the arc of a flat ellipse, encircles the top of the eye, then runs almost straight to the margin again, reaching it a little behind the horizon of the eyes. The eyes are small, minutely faceted, high, and prominent, and have eye-lines which originate opposite the first pair of glabellar furrows and extend to the palpebral lobe. The eyes are situated far forward on the cheeks, and a little nearer to the glabella than to the posterior margin of the cephalon. The distance of the back of the eye from the posterior margin was found, by measurement of many specimens, to be from .40 to .58 of the length of the glabella. The curvature of the head makes the cheeks shorter than the glabella, so that the eyes are really very close to the anterior margin. The neck-furrow is narrow and deep on the fixed cheeks, and on the sides of the glabella, but faint on top. The whole cephalon is surrounded by a convex border which is rather wide on the cheeks, but very narrow in front of the glabella.

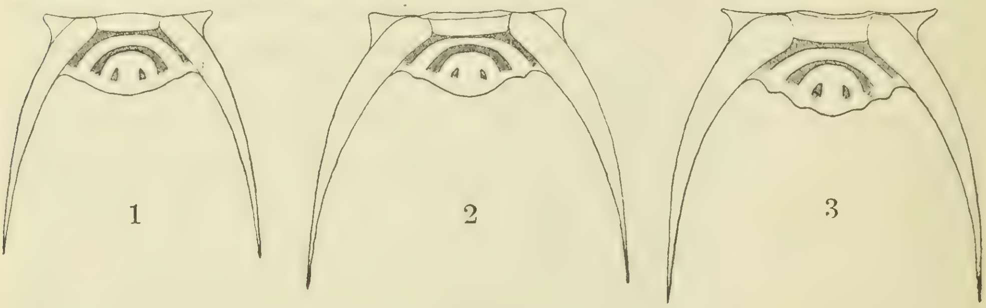
The surface of the cephalon, barring the genal spines, is covered with pits and tubercles of various sizes. On the glabella, there are, beside the numerous irregularly placed ones, two rows of coarse tubercles which are in a rough alignment. These rows diverge toward the front. The fixed cheeks have many tubercles and pits, and behind, and a little inside the eyes, are two small but prominent tubercles on a line parallel to the axis of the animal, and a little inside the line of nodes marking the fulcra of the thorax. On many specimens there is a tubercle on the posterior border in line with these. Well preserved specimens show three or four spine-like tubercles on the posterior border of the cephalon. The surface of the genal spines is granulose.

The thorax is composed of eleven segments, the axial lobe convex, and marked by two rows of small nodes. The pleural lobes are divided into two parts, an inner, solid and nodose portion, and an outer portion consisting of the free ends of the pleura. Along the line dividing these parts, is a series of prominent tubercles, one on each pleuron. In front of each tubercle in this line there is a process which extends under a small fold in the shell of the pleuron in front — the well known fulcral arrangement in trilobites having the power of enrollment. On the inner part of the pleural lobe, the pleura are crossed by deep diagonal furrows which divide this part of each pleuron into convex, triangular pieces. The diagonal line starts at the dorsal furrow on the anterior margin of each pleuron, and runs backward and outward. The nodes thus formed are hollow beneath, and their purpose is evidently to strengthen the shell.

The pygidium is small and short, made up of four ancylosed segments, the first pair of which end in very long, curved, divergent spines. The part of the pygidium within the spines is rounded in outline, and marked by two pairs of ribs which cross the axial portion without a break. The form of the ribs is controlled by the parabolic curve of the great spines, and the third pair make almost a semicircle. The fourth segment is represented by a single ridge running backward on the axial line, within the semicircle formed by the third ribs. Between each pair of ribs are a pair of deep depressions. The ribs extend to, and sometimes cross the narrow convex border. When they cross, they make two pairs of short spines within the great spines, while the central unpaired rib makes a median spine. These spines are never long, and sometimes, when present, they are so short that they merely roughen the outline of the border.

Variations.— The amount of variation among specimens from Trenton Falls is surprisingly slight. As has already been noted, the position of the eye is very constant, and other features, such as the proportion of length of cephalon to width, rate of tapering of glabella, and form of nodes on the thorax, are about the same in all specimens. Moreover, young specimens show very little difference from adults. The smallest specimen at hand, 3 mm. long, has the same number of segments as the adult, the same spines on cheeks and pygidium, the same glabellar furrows, and the same nodes on the thorax. In small specimens, the spines on the pygidium, seem, as a rule, to be more curved, and to have their tips nearer together than in the adult. The average length for specimens at Trenton Falls seems to be about 30 to 35 mm., and the majority of the specimens in the collection are shorter than this. The largest specimen is 58 mm. long, and there are few fragments indicating specimens of larger size. It is important to note that the large specimens have the eyes as far forward as the smaller ones.

The only important variations noted have been in the character of the portion of the pygidium inside the great spines. The posterior border of this part of the pygidium may be either aspinose and rounded, or have 2, 4, or 5 short spines or denticles.



Figs. 1–3 illustrate the three types of pygidium found among the specimens of *Ceraurus pleurexanthemus* at Trenton Falls, N. Y. Some, as in fig. 1, show no traces of spines between the great spines at the sides; others, fig. 2, have one pair of spines; while those like fig. 3 have a suggestion of two pairs of spines between the great spines. A fourth type of pygidium, which is not illustrated, is represented by a few specimens. In this type the middle portion of the pygidium is much like fig. 2, but longer and somewhat shovel-shaped. The figures are drawn from specimens in the Museum of Comparative Zoölogy, (Cat. No. 1, 2, 3) and are 2½ times natural size.

Of sixty-five specimens on which the posterior border of the pygidium could be more or less clearly seen, fifteen had no spines inside the great ones, thirty-seven had only the outer pair, and thirteen had five spines. All but one of the specimens having no spines were small, showing that this was not usually an adult character, but the specimens in the other two groups were of all sizes, showing that the number and size of the spines were not age characteristics.

Measurements.— In the following measurements, the length is taken along the axial line, from the front of the glabella to the middle of the posterior border of the pygidium, and does not include the spines. The width is taken at the genal angles, but does not include the spines.

	1.	2.	3.	4.	5.	6.	7.
Length.	3	8	19	31	36	58	25±
Length cephalon.	.9	2.5	5.5	9.5	11	15	7±
Width.	3	6.5	14	24	27	36	22
Width front glabella.		2	4.5	7	8	13	
Width neck-ring.		1.5	4	6	7	10.5	
Length thorax.				19	22	38	
Length pygidium.				2.5	3	5	
Length spines pygid.		2.5	5			14	

Numbers 4 and 5 are adults of typical size, and number 6 is the largest complete specimen from Trenton Falls. Number 7 is one of the plaster of paris casts of Green's type.

In Vodges's Catalogue of trilobites, nineteen species of "Ceraurus" are listed, but the name is there used in a very wide sense, and includes species of Pseudosphaerexochus, Nieszkowskia, Heliomera, Ceraurus, and Cheirurus. The only species with which *Ceraurus pleurexanthemus* need be compared are *C. dentatus, C. milleranus, C. hudsoni, C. misneri,* and *C. pompilius,* and the differences from each are listed under the appropriate headings on later pages.

Note on Ceraurus pleurexanthemus.— Since the above was written, fascicle 1 of series 4 of the Palaeontologia universalis (dated July, 1912) has come to hand. Leaves 236 and 236a, written by Dr. Rudolph Ruedemann, are devoted to the figures and description of *Ceraurus pleurexanthemus.* The type, which is in the New York State Museum, is represented by a photographic figure which shows more detail than can be seen on Green's casts, and leaves no doubt that the original specimen is conspecific with the individuals so common at Trenton Falls. As plesiotypes, three individuals are illustrated. The first, lettered P, is a fairly well preserved specimen of *Ceraurus pleurexanthemus* from Trenton Falls, but as it has lost both eyes and the pygidium is buried, it does not show the important characters of the species. Through a typographical error, this figure is labeled as enlarged ½ times, but from its size, it would seem that the meaning should be "× 1½." The other two figures, P_1 and P_2, are photographs of casts of two specimens figured by Hall (Pal. N. Y., 1847, **1**, pl. 65, fig. 1m and pl. 66, fig. 1a). The originals of these figures are in the American Museum of Natural History in New York. Both are individuals of our *Ceraurus dentatus.*

Ruedemann has accepted Schmidt's diagnosis of Cheirurus and is therefore led to state that *Ceraurus pleurexanthemus* has the characteristics of Cheirurus *s. s.* This we have shown in the introduction to this paper is not in accordance with the facts. Schmidt was led by his geographical position to accept the northern *Ceraurus exsul* as the type of Cheirurus in place of the proper type, the southern *Cheirurus insignis.*

FORMATION AND LOCALITY.— This species occurs in the Black River and Trenton at almost all localities where these formations are exposed. It is less common in the Lowville, and is not positively known from any formation older than the Lowville, or younger than the Trenton.

CERAURUS DENTATUS, sp. nov.

Plate **1**, fig. 1; Plate **2**, fig. 4, 5.

Ceraurus pleurexanthemus Hall, (*partim*), Pal. N. Y., 1847, **1**, pl. 65, figs. 1d, 1h, 1i, 1m; pl. 66, figs. 1a–1g. Emmons, Geology Second Dist. New York, 1842, p. 390, fig. 6; Amer. geol., 1855, **1**, pl. 15, figs. 1a, 1f, 1h, 1i, 1k. Billings, Geol. Canada, 1863, p. 188, fig. 188. Cumings, 32d Ann. rept. Indiana state geol. surv., 1908, pl. 54, figs. 9–9b, (after Hall).

The larger specimens figured by Hall differ from the typical form of *Ceraurus pleurexanthemus* in having the eyes much further back and without eye-lines, in the possession of much longer and less divergent genal spines, and in having two pairs of well developed spines on the pygidium, within the great spines.

It might seem that these characters were merely the accompaniments of the greater size attained by the specimens, but that such is not the case is shown by the fact that we have before us specimens of *C. dentatus* from Canada which are smaller than the large specimens from Trenton Falls. And, as has already been stated, series of specimens from Trenton Falls show that there is no backward movement of the eye or increase in the length of the genal spines with increase of size.

It is rather peculiar that the only good figure so far ascribed to *Ceraurus pleurexanthemus* should prove to belong to this new species. The figure referred to is the one given by Billings in the Geology of Canada. The Museum of the Geological Survey of Canada does not contain any specimen as perfect as is indicated by this figure, and it is very probable that it is a composite illustration. The general form, the cephalon, and pygidium would appear to have been drawn from specimen No. 1,775, which is now selected as the holotype of *Ceraurus dentatus,* while the thorax and ornamentation were apparently drawn from specimen No. 1,769. The sharp pustules on the posterior border of the cephalon especially are very like those on that specimen. The figure is less than half the size of No. 1,775, but is almost exactly one half the size of a third specimen, No. 1,769b.

Another well known example of this species is the large specimen figured by Hall on Plate 66 of the Paleontology of New York, **1**. This specimen was said by Hall to have come from "near Cincinnati, Ohio," but it is entirely unlike any specimen which has been found in that vicinity since, and very similar to the specimens found in New York and Canada. A recent examination of this specimen in the

American Museum of Natural History in New York shows that the lithology is very unlike the yellow-weathering rock of the Cincinnati region, and, moreover, the specimen is labeled as coming from Middleville, New York.

This species contains the largest specimens of Ceraurus now known. The largest specimen so far seen is one in the Museum of the Geological Survey of Canada. It was collected by the late H. C. Vennor at Belleville, Ontario, and must have been, when complete, over 100 mm. long and 85 mm. wide. It was a veritable giant, when compared with the average specimen of *Ceraurus pleurexanthemus* from Trenton Falls, and nearly double the length of the largest specimens found there. The spines on the pygidia of this species grow to great length. The spines on the type, which is 84 mm. long, are 27 mm. long, and we have seen several which had longer ones. The spines on a pygidium collected by the senior author near the base of the Trenton at Heeley Falls, Ontario are 38 mm. long.

MEASUREMENTS.— The holotype is 83 mm. long, 60 mm. wide at the genal angles, the cephalon is 24 mm. long, the glabella 17.5 mm. wide at the front and 15.5 wide at the neck-ring. A somewhat smaller specimen from Cobourg, Ontario, is 74 mm. long, 54 mm. wide at the genal angles, the cephalon is 22.5 mm. long, the glabella is 17.5 mm. wide at the front and 13.5 wide at the neck-ring.

FORMATION AND LOCALITY.— This species is, so far as we now know, confined to the Trenton, but it seems to be found all through that formation, although especially common in the lower part. It is known to occur at the following localities, and it will probably be found at numerous other places, especially in the Central States:— Middleville, New York (exact horizon not known); Roaring Run, East Martinsburg, New York, (in strata corresponding to the crinoid beds of the Ontario section); Belleville, Ontario, (crinoid beds); Cobourg, Ontario, (sponge beds at top of Trenton); Heeley Falls, Ontario, (Dalmanella beds at base of Trenton); Trenton and Peterboro, Ontario, (Prasopora beds); Fenelon Falls and Kirkfield, Ontario, (crinoid beds, very common). The type was collected at Van Kleek Hill, east of Ottawa, Ontario, by Sir William Logan, and the exact horizon is not known.

CERAURUS HUDSONI Raymond.

Ceraurus hudsoni Raymond, Annals Carnegie mus., 1904, **3**, p. 367, pl. 14, fig. 15; 7th rept. Vermont state geol., 1911, p. 24, pl. 36, fig. 15.

This species was described as differing from *Ceraurus pleurexanthe-*

mus in having the eyes further forward and the cheeks more convex, but the figures in the Palaeontology of New York with which comparison was made were those which we now refer to *C. dentatus*. *Ceraurus hudsoni* has the flaring spines of *C. pleurexanthemus*, and the eyes agree with that species in being nearer to the glabella than to the posterior margin of the cephalon. The glabella seems to be broader and less convex than in *C. pleurexanthemus*, and the rate of expansion is a little greater (about 1 mm. in 4). There is, however, little difference between the two species, so far as can be seen in the incomplete specimens so far found.

FORMATION AND LOCALITY.— This species has been found only in the Middle Chazy on Valcour Island, New York.

CERAURUS GRANULOSUS, sp. nov.

Ceraurus pompilius Raymond (non Billings), Annals Carnegie mus., 1904, **3**, p. 365–6 (not fig. 6), pl. 14, fig. 14; 7th rept. Vermont state geol., 1911, p. 240, pl. 36, fig. 14.

This species was originally identified by Raymond with Billings's species, *Cheirurus pompilius*. Billings's figure shows the glabella of *Ch. pompilius* to be smooth and his description states that the cheeks are punctured. The specimens from Sloop Bay, identified by Raymond as *Ch. pompilius*, have the whole surface papillose, the pustules being small and thickly scattered over the glabella and cheeks, but rather sparingly on the margins and spines. It therefore seems best to refer these specimens from Sloop Island to a new species.

From *Cheirurus pompilius* Billings, *Ceraurus granulosus* is distinguished by the granulose condition of the cephalon and from the other species of Ceraurus, by the parallel-sided glabella, and by the faint granulation.

FORMATION AND LOCALITY.— Trilobite Layers, Chazy, Sloop Bay, Valcour Island, N. Y.

CERAURUS BISPINOSUS, sp. nov.

Plate **1**, fig. 3, 4.

This species is known only from a fragmentary specimen of a cephalon showing the glabella and one fixed cheek. The fragment shows *C. bispinosus* to have been a ceraurid of medium to large size. The cephalon is roughly semicircular, and about 0.45 as long as broad. The glabella is very convex, expanding forward and reaching the frontal margin. The expansion is about 1 mm. in 4. The frontal lobe and the first pair of glabellar lobes are much more convex than the posterior ones and compose about two thirds of the glabella. There are three pairs of glabellar furrows; of these, only the posterior pair are deeply incised. There is further a slight constriction running backward from the inner end of each of these two furrows to the neck-furrow. The fixed cheeks are very convex, highest at the eye, and are separated from the glabella by deep dorsal furrows. The free cheeks are apparently small. The eyes are situated far forward on the cheeks and are nearer the glabella than the posterior margin of the cephalon. The distance of the eye from the posterior margin of the cephalon is about 0.5 the length of the glabella. A faint eye-line is present. The neck-furrow is narrow and moderately deep. The whole cephalon is surrounded by a convex border which is rather wide on the cheeks, but very narrow in front of the glabella. The cephalon is covered with scattering pustules and the cheeks are in addition thickly indented with small pits. On the glabella, three pairs of pustules, two on the frontal lobe and one on the first segment are more strongly developed than the rest of the pustules. Of these, the second pair are the largest and resemble a pair of short, heavy, horn-like spines.

Remarks.— In the general appearance of the cephalon, barring the glabellar spines, *C. bispinosus* is similar to *C. dentatus* and to *C. pleurexanthemus*. In size, however, it is nearer the former than the latter, while the reverse is true with regard to the position of the eye and the eye-lines. The eyes are, however, slightly farther out and forward than in *C. pleurexanthemus*. *C. bispinosus* is most readily distinguished from the other species by the presence of the thick short horn-like spines on the crest of the frontal lobe and by the rapid expansion of the glabella. This species is known only from a single specimen, collected near Ottawa, by Mr. J. E. Narraway, in whose collection the holotype now is.

There was also found the larger part of a free cheek, which may possibly belong to this species. The cheek is roughly triangular, with a curving edge, and is separated from the border by a deep narrow groove. The cheek is slightly convex and is covered with deep pits and small spinules. The facial suture runs backward from the anterior in a gentle curve, curves about the eye, and again gently curving, runs outward to the border. The border is broad, convex, and covered with coarse granules. The animal to which this cheek belonged was large, apparently two or three times the size of the one to which the type belonged.

FORMATION AND LOCALITY.— *Ceraurus bispinosus* is known only from the Black River limestone, Tetreauville, P. Q.

CERAURUS MILLERANUS Miller and Gurley.

Plate **1**, fig. 6–8; Plate **2**, fig. 6.

? *Calymene bucklandi* Anthony, Amer. journ. sci., 1839, **36**, p. 106, fig. 1, 2.

Ceraurus milleranus Miller and Gurley, Bull. Illinois state mus. nat. hist., 1893, p. 80, pl. 8, fig. 10.

Ceraurus does not seem to be particularly plentiful in the vicinity of Cincinnati, and the vertical range would appear to be very limited. According to Nickles, (Journ. Cinc. soc. nat. hist., 1902, **20**, no. 2), *Ceraurus milleranus* is found only in the Corryville division of the Lorraine.

In the Dyer collection in the M. C. Z. there are a number of specimens of Ceraurus collected at Cincinnati, none of them absolutely complete, but several of them nearly entire, and well preserved. These specimens differ from specimens of *Ceraurus pleurexanthemus* at Trenton Falls in having shorter and less flaring spines at the genal angles, and in having the eyes less elevated, and further back.

Two names have been applied to the Cerauri at Cincinnati. The *Calymene bucklandi* of Anthony is evidently, from the figure, a Ceraurus, but the revival of his name is objectionable, because the type is not now accessible, the figure and description are poor, and the original specimen is not complete enough to show the important characters, should it ever be found. The other name, *Ceraurus milleranus*, is open to many of the same objections, but fortunately we have, through the kindness of Professor Weller, been able to study the type, which is No. 6,062 in the collection at the Walker Museum of the University of Chicago. This specimen agrees with the other specimens from Cincinnati in the length of the genal spines and the position of the eyes, but the pygidium is peculiar, in having the tips of the great spines very close together. We have before us twenty good pygidia from Cincinnati, and none of them show this feature, although there is some approximation toward it in one or two specimens. We believe that this feature, which Miller and Gurley considered the most important of their specific characters, is really due to a deformation of the specimen. Measurements have failed to confirm the statements of Miller and Gurley that this Ceraurus has a shorter cephalon, wider frontal lobe on the glabella, or a wider and less convex thoracic axis than *C. pleurexanthemus.* Their other points, the shorter and thicker spines on the cheeks, and the thicker and straighter spines on the pigidium, we believe to be well taken, and we would add to them the less convex glabella and the lower eyes, whose position is further back than in *C. pleurexanthemus.* In the matter of the position of the eyes, *C. milleranus* is intermediate in position between *C. pleurexanthemus* and *C. dentatus.* In *C. pleurexanthemus* the eye is further from the posterior margin of the head than from the glabella. In *C. milleranus* it is equidistant from the posterior margin and the glabella, while in *C. dentatus* it is nearer the posterior margin than the glabella.

The part of the pygidium of *C. milleranus* which is between the great spines has a rather undulate marginal outline. The second segment sends off short spines which extend beyond the margin, but they are so short and blunt that they merely make an undulation on the margin. All the specimens seem to be of this same type. The pygidia are, in this respect, very unlike those of *C. dentatus,* but similar to a part of the specimens of *C. pleurexanthemus.*

MEASUREMENTS.— *Ceraurus milleranus* is of about the same size as *C. pleurexanthemus* and about the same general proportions. The type is 39 mm. long without the pygidial spines, or 45.5 mm. long with them. The width at the genal angles is 22 mm., the cephalon is 9 mm. long, the glabella 7 mm. wide at the front and 6 mm. wide at the neck-ring. A larger cephalon is 13 mm. long and 31 mm. wide.

FORMATION AND LOCALITY.— This species has been reported only from the Lorraine in the vicinity of Cincinnati. Cumings (32d Ann. rept. Indiana state geol. surv., 1908, p. 1059) records a pygidium of Ceraurus from the Lorraine at Manchester, Indiana, which may possibly be this species.

CERAURUS MISNERI Foerste.

Ceraurus misneri Foerste, Bull. Denison univ., 1909, **14**, p. 228, pl. 4, figs. 7A, 7B.

The holotype of this species was found in the Whitewater bed of the Richmond at Richmond, Indiana. It appears, from the photographic illustrations given by Dr. Foerste, to be closely allied to *Ceraurus milleranus,* but differs in having a longer cephalon, a more rapidly expanding glabella, and in lacking spines at the genal angles. Foerste states that the glabella is 5.5 mm. wide at the back, and 9 mm. wide at the front. As the glabella is 11 mm. long, the rate of expansion is much greater than in *Ceraurus milleranus, C. dentatus,* or *C. pleurexanthemus.* The eyes are about equally distant from both glabella and the posterior margin of the cephalon, as in *C. milleranus.* The species shows an approach to Cheirurus, in that the glabella occupies a large portion of the cephalon. The pygidium was not described by Foerste, and probably is not preserved on the type.

FORMATION AND LOCALITY.— A rare species in the Whitewater bed at the top of the Richmond, at Richmond, Indiana, and Dayton, Ohio.

CERAURUS NUMITOR (Billings).

Plate 1, fig. 5.

Cheirurus numitor Billings, Catal. Silurian fossils of Anticosti. Geol. surv. Canada, 1860, p. 27, fig. 11.

This trilobite is rare and not at all well known, but is remarkable for the possession of a long and stout spine which projects upward and backward from the neck-ring. No other Ceraurus is known with such a spine, and in the whole family of the Cheiruridae this feature is paralleled only in the rare genus Youngia. Nieszkowskia, it is true, has a central spine on the cephalon, but it springs from the glabella and not from the neck-ring. Somewhat over-rating the importance of this unusual spine, we were at first inclined to refer the species to Youngia, but it seems to be a true Ceraurus. Billings described the glabella as subcircular, which would make it in agreement with that of Youngia.[1] Billings's type is lost, but a specimen in the M. C. Z. collected in Anticosti by the Shaler Expedition, although poor, shows that the glabella expands forward and is covered with pustules as in Ceraurus. Moreover, the posterior glabellar furrows are deep, rather wide, and are nearly perpendicular to the axis of the glabella, instead of being faintly impressed and curving backward as in Youngia. This specimen also shows that the eye is far forward, as in *C. bispinosus.* The neck-spine, is, unfortunately, broken off. The pustulose character of the glabella and the direction of the posterior glabellar furrows exclude this species from Cheirurus.

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[1] See Lindstroem, Foerteckning pa Gotlands Siluriska Crustaceer. Kongl. vet.-Akad., Foerhandlingar, 1885, no. 6, p. 49, pl. 18, fig. 11; also Reed, the Lower Paleozoic trilobites of Girvan. Palaeontogr. soc., 1906, p. 148, pl. 19, fig. 8–12, *Cheirurus trispinosus* Young, is the type.

FORMATION AND LOCALITY.— This species is very rare in the English Head formation, (Richmondian), at English Head, Anticosti.

SPECIES INCORRECTLY REFERRED TO CERAURUS.

ENCRINURUS RARUS (Walcott).

Plate 2, fig. 3.

Ceraurus rarus Walcott, 31st rept. N. Y. state mus. nat. hist., 1877, p. 15 (advance sheets); 31st rept. N. Y. state mus. nat. hist., 1879, p. 68.

Through the kindness of Professor Weller we have been able to see the type of this species. The specimen now belongs to the Walker Museum at the University of Chicago, and bears the number 12,322. It retains only the glabella and a part of one fixed cheek, and is 3 mm. long. The glabella is very narrow in front of the neck-ring, but expands rapidly toward the front. The glabella differs from that of any known species of Ceraurus in that it contracts in front of the neck-ring, so that the sides are not straight, but concave toward the fixed cheeks. The posterior pair of lobes are also extremely small, and not isolated, the last furrows being straight. All of the glabellar furrows are straight, or turn a little forward at their inner ends, none of them turning back as in nearly all species of Ceraurus. These features excite suspicion as the generic identification of the specimen.

The specimen was collected at Beloit, Wisconsin, and Dr. Clarke has described, from that same locality, a species which he called *Encrinurus vannulus.* Although the figure given by Clarke[1] is poor, his description fits the present specimen exactly. He says, in part:— "Lateral furrows obscure, but still more distinctly developed than is usual in this genus. The first pair lies a short distance from the anterior extremities of the dorsal furrows, is short, and directed somewhat anteriorly, the second and third furrows are but slightly longer, somewhat more transverse. . . . Occipital ring broader than the lateral slopes, and expanding considerably beyond the base of the glabella."

As there can be no doubt that Dr. Clarke's specimens belong to the genus Encrinurus, and as *Ceraurus rarus* is from the same locality, and seems to be almost identical with Clarke's specimens, it will be necessary to remove *Ceraurus rarus* to the genus Encrinurus. The type of *Encrinurus rarus* (Walcott), is so small and fragmentary that it may be impossible to decide whether or not it is the same as *Encrinurus vannulus* Clarke, so that, at least until new material is obtained, it will be better not to unite the two species.

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[1] Paleontology Minnesota, 1897, 3, pt. 2, p. 739, fig. 56.

Walcott's specimen is 3.5 mm. long, and the glabella is 3 mm. wide at the anterior end, and 1.5 mm. wide at the posterior lobes.

FORMATION AND LOCALITY.— Lower Trenton, Beloit, Wisconsin.

EOHARPES PUSTULOSUS (Hall).

Ceraurus ? pustulosa Hall, Pal. N. Y., 1847, **1**, p. 246, pl. 61, fig. 2a–h.

Harpes pustulosa Whitfield and Hovey, Bull. Amer. mus. nat. hist., 1898, **11**, p. 68.

The senior author has seen the type of this species in the American Museum of Natural History and agrees with Whitfield and Hovey that it belongs to the Harpedidae. Whether it is to be identified with the widespread, though rare, *Eoharpes ottawaënsis* cannot be determined until a more careful revision of our American Harpedidae is undertaken.

FORMATION AND LOCALITY.— Hall reports the specimen as having come from the upper part of the Black River limestone at Watertown, New York.

OTHER SPECIES COMMONLY LISTED AS CERAURUS.

Beside the above species, wrongly listed as Ceraurus, Vogdes's Catalogue contains a number of other species which obviously do not belong to the genus as now restricted.

Cheirurus apollo Billings, may be an Anacheirurus, (not Pseudosphaerexochus as has been supposed by Raymond). *Cheirurus glaucus* Billings, *Ch. satyrus* Billings, and *Ch. perforator* Billings, belong to Nieszkowskia. *Cheirurus vulcanus* Billings, *Ch. prolificus* Billings, and *Ch. mercurius* Billings, seem to belong to Pseudosphaerexochus. *Ceraurus niagarensis* Hall, *Ch. tarquinius* Billings, *Ch. nuperus* Billings, and *Ceraurus hydei* Weller, are species of Cheirurus, though the last two show a curious parallel development in that they have a Ceraurus-like pygidium. *Cheirurus sol,* though very imperfectly known, was made the type of the genus Heliomera by Raymond. And lastly, *Cheirurus icarus* Billings, *Ch. polydorus* Billings, and *Ch. pompilius* Billings, form a group to which the junior author of this paper is giving a new name.

The European genera Eccoptochile, Actinopeltis, Areia, Youngia, Cyrtometopus, and Crotalocephalus do not appear to have been recognized as yet on the North American continent.

PLATE 1.

Fig. 1. *Ceraurus pleurexanthemus* Green. A restored figure, based principally on the specimen, (No. 4 Coll. M. C. Z.), Plate **2**, fig. 1. The posterior part of the pygidium is restored from another specimen (No. 2 Coll. M. C. Z.). The top of the left eye is incomplete, as in the specimen, while the right eye is restored. The specimens on which this figure is based are from the Trenton at Trenton Falls, N. Y., Coll. M. C. Z. The figure is one half larger than natural size.

Fig. 2. *Ceraurus dentatus* Raymond and Barton. A typical pygidium from the Trenton at Watertown, N. Y. The specimen is No. 7 Coll. M. C. Z. and the figure is one half larger than natural size.

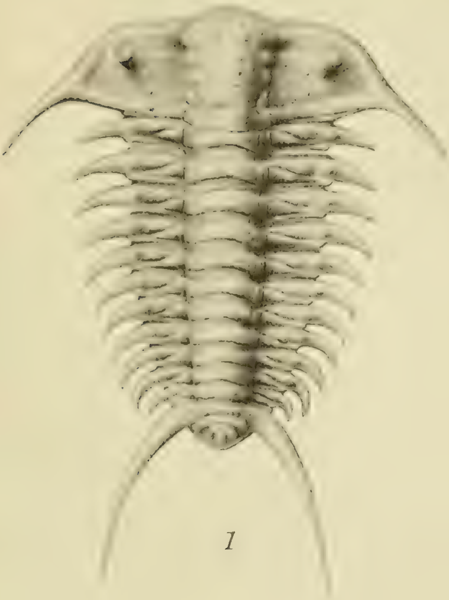
Fig. 3, 4. *Ceraurus bispinosus* Raymond and Barton. Figure 4 represents the incomplete cranidium which is the holotype of this species, and fig. 3 was made from a free cheek which is believed to belong to the same species. Both specimens are in the private collection of Mr. J. E. Narraway of Ottawa, Ontario, and are from the Black River limestone at Tetreauville, Que. The figures are one half larger than natural size.

Fig. 5. *Ceraurus numitor* (Billings). An incomplete cranidium, from which the neck-spine is broken. From the English Head formation (Richmondian) at English Head, Anticosti. The specimen is No. 8 Coll. M. C. Z., and the figure is one half larger than natural size.

Fig. 6. *Ceraurus milleranus* Miller and Gurley. A small enrolled specimen from the Lorraine at Cincinnati, Ohio. A part of the pygidium projects from beneath the glabella. The specimen is No. 9 Coll. M. C. Z., and is two and one half times natural size.

Fig. 7. The same species. A nearly complete specimen (No. 10 Coll. M. C. Z.) from the Lorraine at Cincinnati, Ohio. The figure is one tenth less than natural size.

Fig. 8. The same species. A photograph of the holotype, which was collected from the Lorraine at Cincinnati, Ohio, and is now in the Walker Museum at the University of Chicago. The figure is one sixth less than natural size.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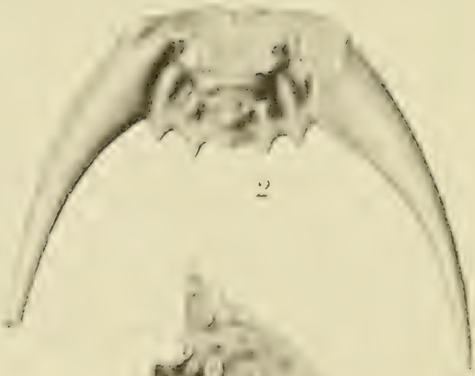
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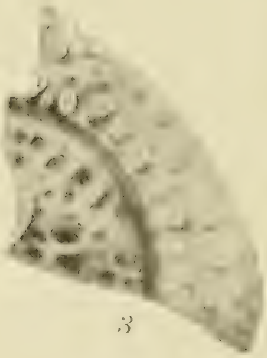
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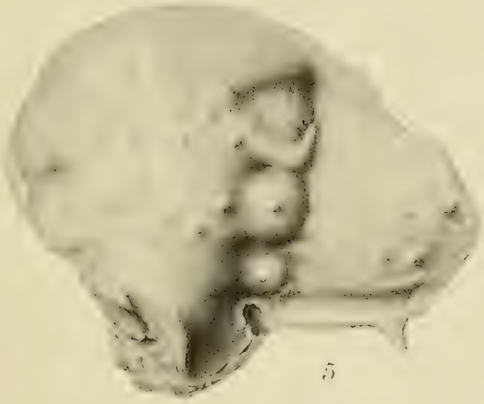
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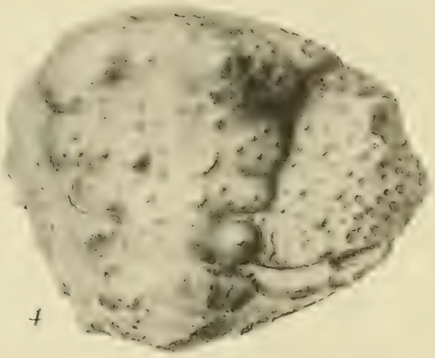
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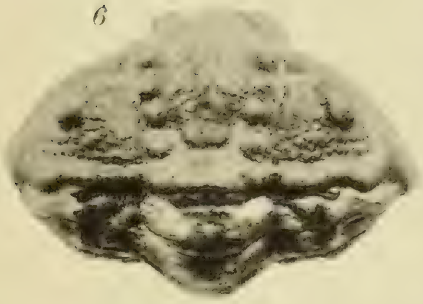
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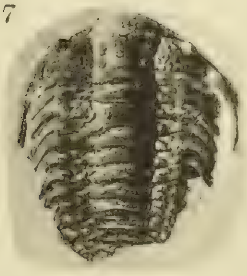
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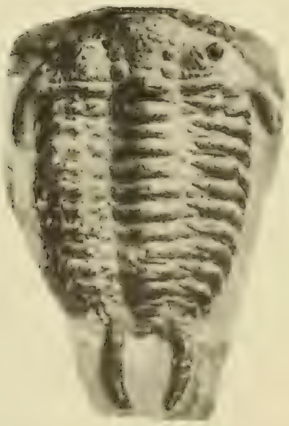
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PLATE 2.

Fig. 1. *Ceraurus pleurexanthemus* Green. The specimen (No. 4 Coll. M. C. Z.) on which figure 1 of the preceding plate was based. It is from the Trenton limestone at Trenton Falls, N. Y. The figure is two thirds larger than natural size.

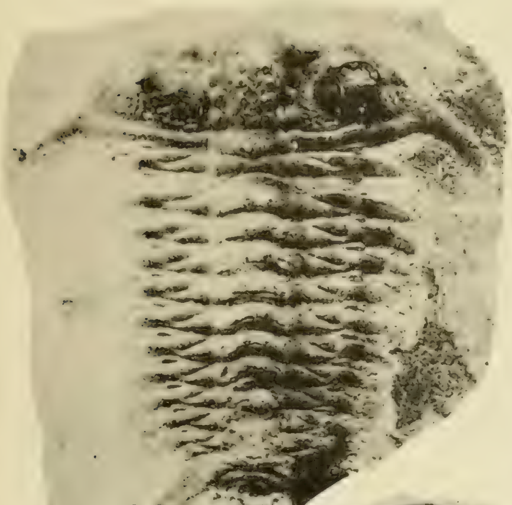
Fig. 2. The same species. A photograph of a specimen 8 mm. long, (No. 5 M. C. Z.) introduced to show the similarity of the young to the adult. The specimen is from the same locality as the last, and the figure is five eighths larger than the specimen.

Fig. 3. *Encrinurus rarus* (Walcott). A photograph of the specimen described by Walcott as *Ceraurus rarus*. It is from the Lower Trenton at Beloit, Wisconsin, and is now in the Walker Museum at the University of Chicago. The figure is of natural size.

Fig. 4, 5. *Ceraurus dentatus* Raymond and Barton. The holotype of the species, figure 4 showing the hypostoma, which is attached to the doublure in its natural position. The specimen is from the Trenton at Van Kleek Hill, Ontario, and has been for many years in the Museum of the Geological Survey of Canada. The figure is of natural size, the photograph was made by the Geological Survey of Canada, and is published with the permission of the Director.

Fig. 6. *Ceraurus milleranus* Miller and Gurley. A pygidium from the Lorraine at Cincinnati, Ohio. The specimen is No. 11 Coll. M. C. Z., and the figure is one seventh larger than natural size.

Fig. 7. *Ceraurus pleurexanthemus* Green. A photograph of the test showing the under surface. The specimen is from the Trenton at Trenton Falls, N. Y., and is No. 6 Coll. M. C. Z. The figure is two thirds larger than natural size.



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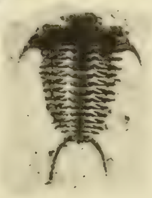

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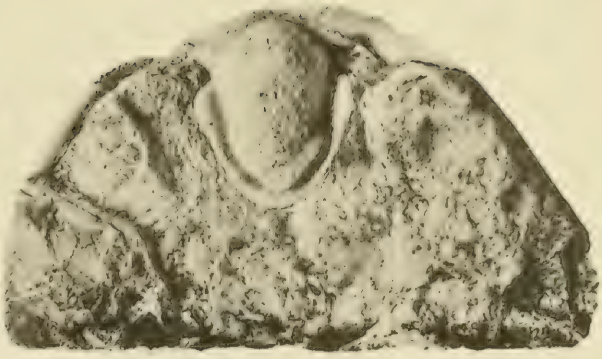

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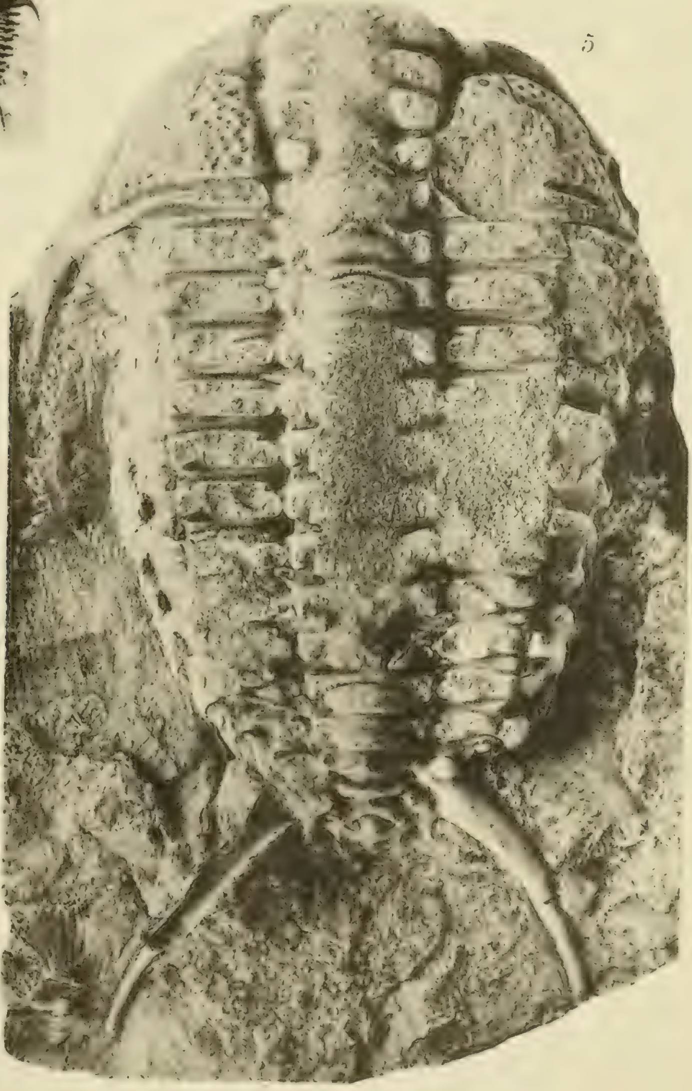

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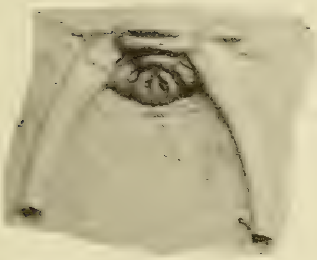

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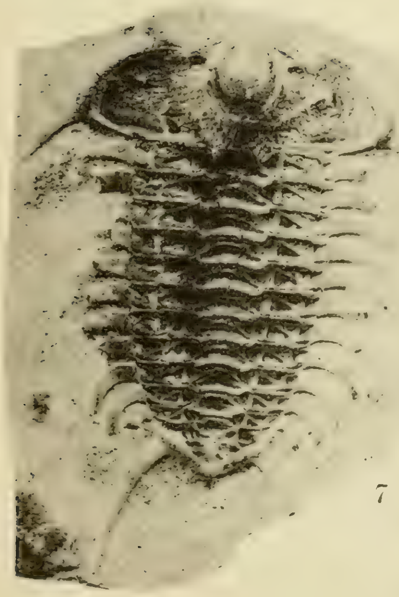

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A NEW GENUS OF THE CHEIRURIDAE, WITH DESCRIPTIONS OF SOME NEW SPECIES.

By Donald C. Barton.

With One Plate.

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No. 21.— *A new Genus of the Cheiruridae, with Descriptions of some new Species.*

By Donald C. Barton.

The genus Cheirurus Beyrich, has been divided into numerous subgenera or genera. Schmidt [1] restricts Cheirurus in a subgeneric sense to those cheirurids having eleven thoracic segments, the inner part of the pleuron divided by a diagonal furrow, and the glabella expanding slightly forward. Reed [2] follows Schmidt, but goes further and distinguishes Crotalocephalus Salter. *Cheirurus insignis* Beyrich, not *Cheirurus exsul* Beyrich, as Reed gives it,[3] is however, the genotype of Cheirurus. In a previous paper the necessity has been shown for distinguishing between Cheirurus and Ceraurus. In the present paper it is proposed to separate a new genus from Cheirurus.

Cheirurus as represented by *Ch. insignis* Beyrich, has nearly straight posterior glabellar furrows that open on the neck-furrow at or near the central axis of the glabella. The basal lobes are triangular and are not separated by a portion of the glabella. The glabella is smooth and expands forward.

The posterior glabellar furrows of Ceraurus are less than one third the width of the glabella in length and do not open directly into the neck-furrow, but are connected with it by a longitudinal constriction. The basal lobes are small and are separated by a portion of the glabella that, in width, is at least one third of the total width of the glabella at that point. The glabella and cheeks are pustulose and the glabella expands forward.

There is a group of species including *Cheirurus icarus* Billings, *Cheirurus pompilius* Billings, *Cheirurus ingricus* Schmidt, *Cheirurus ornatus* Dalman, and others, which have always been included in Cheirurus in the restricted sense of Schmidt and Reed, but which show certain constant differences. The posterior glabellar furrows are straight, are about one third the width of the glabella in length, and do not open into the neck-furrow. Their inner ends are connected with the neck-furrow by a curving constriction that is roughly parallel to the axis of the glabella. The basal lobes are ovate and are separated by a portion of the glabella which, in width, is less than one third the width of the glabella at that point. The glabella is smooth, and the cheeks are pitted. The sides of the glabella are usually parallel, but may diverge slightly toward the front. The differences from Cheirurus and from Ceraurus seem to be fairly constant, and this group seems, therefore, to be worthy of generic rank.

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[1] Revision der Ostbaltischen Silurischen trilobiten. Mem. Acad. imp. sci. St. Petersburg, 1881, ser. 7, **30**, no. 1, p. 122.

[2] Evolution of Cheirurus. Geol. mag., 1896, dec. 4, **3**, p. 117, *et seq.*

[3] Loc. cit., p. 117.

Description.— Ceraurinus is in general appearance and size much like Cheirurus (genotype *C. insignis* Beyrich). The glabella is subrectangular or expands only slightly. The posterior of the three pairs of glabellar furrows are straight, about one third the width of the glabella in length and slope gently backward. Their inner ends are connected with the neck-furrows by curving constrictions which are about parallel to the axis of the glabella. The constrictions are strong in some species and very faint in others. The middle part of the axial portion of the neck-furrow is parallel to the posterior edge of the neck-segment. The outer thirds each slope gently backward. The eyes are large for a cheirurid and are somewhat Asaphus-like.

The thorax is presumably of eleven segments. The axial lobe is slightly less than one third of the width of the thorax and tapers gently backward. Each pleuron is divided by a node-like constriction into a large inner third and a small outer two thirds. The inner third bears a deeply impressed diagonal pleural furrow.

The pygidium, well known only in *Ceraurinus icarus* (Billings), is composed of three (four), segments ending in six free spines, which are of about equal length.

The type is *Ceraurinus marginatus*, sp. nov.

Remarks.— The American species of this genus are *Ceraurinus marginatus*, sp. nov., *Cheirurus icarus* Billings, *Ceraurinus trentonensis*, sp. nov., *Cyrtometopus scofieldi* Clarke, *Cheirurus polydorus* Billings, and *Cheirurus pompilius* Billings. In the U. S. National Museum there is a specimen from the Echinosphaerites limestone (C) of Russia, which might almost be mistaken for *Ceraurinus trentonensis*, and which also corresponds very closely to the descriptions of *Cheirurus ingricus* Schmidt, and of *Cheirurus ornatus* Dalman. These latter species seem to belong to this genus. From Barrande's figures, *Cheirurus comes* Barrande, would seem possibly also to belong to Ceraurinus. The genus may also be represented in India. Reed [1] places the affinities of *Cheirurus mitis* Salter, with *Ch. ornatus* Dalman, *C. exsul* Beyrich, and *C. macropthalmus* Kutorga, but especially with the first. He also says that it may be compared with *Cheirurus polydorus* Billings. Of the specimens figured by Reed the greater number would seem to me to be of the type of the Russian Ceraurus rather than of Ceraurinus. Figures 18 and 20, plate 15, however, resemble very closely *C. ornatus* Dalman, and *C. polydorus* Billings.

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[1] Ordovician and Silurian fossils from the Central Himalayas. Palaeontol. Indica, 1912, ser. 15, **7**, Mem. 2, p. 10.

Of the actual homogeneity of this genus I have some doubts. *Ceraurinus marginatus*, *C. icarus*, *C. scofieldi*, and possibly *C. pompilius*, would seem to form one group. *Ceraurinus trentonensis* and *C. polydorus* each present a slightly different aspect. The Russian form that I have seen resembles *Ceraurinus trentonensis* rather than the others. The Bohemian form differs slightly in aspect from all the others.

Key to Species of Ceraurinus.

A. Glabella expanding slightly forward.
  a. Anterior two pairs of glabellar furrows straight or nearly straight *ornatus* Dalman
  b. Anterior two pairs of glabellar furrows curving *trentonensis*, sp. nov.
B. Glabella with parallel or faintly convex sides
  a. Glabellar furrows curving
    I. Glabella and cheeks moderately convex
      Surface of the glabella smooth........ *polydorus* Billings
      Surface of the glabella shagreened....... *ingricus* Schmidt
      Glabella and cheeks not very convex
      Glabella strikingly rectangular (although with rounded corners)............................ *comes* Barrande
  b. Glabellar furrows straight or nearly straight
    II. Basal lobes not separated from the body of the glabella or only faintly separated
      The three pairs of glabellar furrows perpendicular to the dorsal furrows and nearly parallel to each other. *marginatus*, sp. nov.
      Posterior pair of glabellar furrows inclined slightly backward and faintly curving at the inner ends.. *ornatus* Dalman
      Posterior pair of glabellar furrows straight and inclined strongly backward.................... *scofieldi* Clarke
      Posterior pair of glabellar furrows not reaching the dorsal furrows.......................... *confluens*, sp. nov.

Basal lobes completely separated from the body of the glabella.
Neck-furrow strongly convex forward.....*icarus* Billings
Axial portion of neck-furrow only strongly convex forward *pompilius* Billings

CERAURINUS MARGINATUS, sp. nov.

Plate, fig. 1.

This species is known from a single specimen, which, with the exception of the posterior segments of the thorax and the pygidium, is nearly perfect.

The cephalon is semicircular, of moderate convexity, and bounded by a broad marginal border, which is one of the most distinguishing features of this species. The glabella is subrectangular, rounded in front, and is slightly convex. The glabellar furrows are sharply and deeply incised and are about one third the width of the glabella in length. They are almost at right angles to the parallel sides of the glabella, but slope very slightly backward. The posterior three glabellar lobes are about of a size. The frontal lobe is slightly larger. The constriction connecting the inner ends of the posterior pair of glabellar furrows with the neck-furrow is extremely faint. The glabella is smooth. The cheeks are large, triangular, slightly convex, and faintly pitted. The eye is in the middle of the cheek, opposite the second glabellar furrow, and is moderately large and Asaphus-like. The faceted surface slopes outward instead of being vertical as in most of the Cheiruridae. The palpebral lobe is large and triangular with a linear depression on its upper surface. A strong eye-line runs from the base of the palpebral lobe to the base of the first pair of glabellar furrows. The facial suture, running forward from the tip of the palpebral lobe, bends inward and cuts the anterior margin in front of the glabella. From the tip of the palpebral lobe, the posterior portion of the facial suture at first curves backward and then curves outward, convex to the anterior, till just across the lateral furrow. It then slants diagonally across the border and cuts the margin just in front of the genal angle.

Thorax probably of eleven segments. The type is imperfectly preserved after the tenth thoracic segment. The axial lobe is convex, about one fourth the width of the thorax in width and tapers gently backward. Each pleuron is divided by a node-like constriction into an inner third and an outer two thirds. The inner third is subrectangular and cut by a diagonal furrow. The outer two thirds is long, tapering, and somewhat lanceolate.

Measurements. —	Length of cephalon	27 mm.
	Width of cephalon at neck-ring	55 ±
	Length of glabella	20
	Width of glabella at frontal lobe	16.5
	Width of glabella at basal lobe	17.0
	Position of the eyes	
	Ratio of dist. eye[1] to the posterior margin to the length of the cephalon	0.44
	Ratio of dist. eye to glabella to the length of the cephalon	0.26

This species is apparently allied to *Ch. icarus* Billings, but is distinguished from that species by the unisolated basal lobes of the glabella, by the broader margin of the cephalon, and by the more slender and tapering pleura.

Formation and Locality.— The Richmond of the Province of Ontario. The type (M. C. Z. No. 12 Walcott collection) is probably from Manitoulin Island, Lake Huron.

Ceraurinus icarus (Billings).

Plate, fig. 7.

Cheirurus icarus Billings, Can. nat. & geol., 1860, **5**, p. 67, fig. 2.

Ceraurus icarus Meek, Ohio pal., 1873, **1**, p. 162, pl. 14, fig. 2a, b, c.

Ceraurus meekanus Miller, N. Amer. geol. & pal., 1889, p. 537.

The name *Ceraurus meekanus* was proposed by Miller for the forms figured by Meek from Richmond, Indiana, as *C. icarus* Billings. This form must, however, be referred to *Ch. icarus* Billings.

Miller, in his definition of *C. meekanus,* says, "distinguished [from *Ch. icarus* Billings] by the form of the glabella, by the furrows, structure of the thorax, and form of the central lobe, and by the pygidium, besides occurring in higher rocks and growing to a much larger size."

Billings's figure of *Ch. icarus* is poor, and his type is lost, but his description is most minute. The pertinent points of it are:— glabella

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[1] From tip of palpebral lobe.

oblong, sides parallel, obtusely rounded in front, neck-segment elevated at the posterior margin; neck-furrow in its middle-third parallel with the posterior margin; at each end for one third the length sloping backward; the posterior lobe of the glabella transversely oval, completely isolated; the median furrows lying nearly in a line across the glabella at midlength, nearly straight, and each in length about one third the width of the glabella; the anterior pair at a little more than one fourth the length from the front, curved slightly backward and inward. Thorax nearly twice the length of the glabella; the axis less than one third the whole width, gently tapering backward; the pleural groove short, in length about one half the width of the axis, crossing the pleura obliquely outward and downward at an angle of about 45°; pygidium about half the length of the glabella, composed of three articulations, the backward curving extremities of which form six short obtuse points.

A comparison of figure 7, a reproduction of the type of *C. meekanus*, with this description of *Ch. icarus* Billings, will serve to show the identity of the Richmond form with Billings's species. This description, both in the abridged form just given and in its entirety, are in perfect accord with *C. meekanus* Miller, and might well have been written of it. As only a few specimens are known of either form, the supposed difference in size, cited by Miller, would not seem to be sufficient to constitute a specific distinction. The supposed difference in horizon which Miller cites is now known not to exist. For these reasons it seems best to consider *C. meekanus* Miller as a synonym of *Ch. icarus* Billings.

Ch. icarus Billings is not placed under Ceraurus on account of the smoothness of the glabella and of the subequality of the pygidial spines. It is not placed under Cheirurus on account of the course of the posterior pair of glabellar furrows, and is, therefore, referred to Ceraurinus.

Ceraurinus trentonensis, sp. nov.

Plate, fig. 5–6.

Glabella of medium size, two thirds as wide as long, expanding slightly forward, the three posterior glabellar lobes of about equal size, the frontal lobe larger and forming about one third of the glabella. The two anterior pairs of glabellar furrows are sharply incised, but are not broad; they curve inward and gently backward till about three eighths of the distance across the glabella. The posterior pair of glabellar furrows are straight, deep, and moderately broad, they slope gently backward, and are about one third the width of the glabella in length. At their inner ends a curving constriction connects them with the neck-furrow. The neck-furrow is well marked, in its middle-third of the axial portion parallel to the posterior margin of the neck-segment, in the two outer thirds sloping backward. The glabella is smooth. The fixed cheeks are of medium size and are faintly pitted. The genal angles are produced into short spines. The palpebral lobe is situated opposite the second and third glabellar furrows. It is triangular, with a thickened edge, and with a deep rounded furrow on the upper surface of the lobe. From the palpebral lobe a faint eye-line runs to the base of the anterior pair of glabellar furrows.

The hypostoma is, in general form, similar to that of *Cheirurus insignis* Beyrich, but at its posterior end, is slightly more rounded, and its lateral depressions do not run quite so far back before bending in. It is distinguished from the hypostoma of Ceraurus by the fact that in the latter, the lateral depressions do not turn in, by a much more rounded posterior point than the latter, and the more rounded termination to the border.

Ceraurinus trentonensis differs slightly from other members of the genus. The forward expansion of the glabella distinguishes it from all the other species except *Cheirurus ornatus* Dalman, but in this latter species the expansion of the glabella is very slight. The two pairs of curving anterior glabellar furrows are also not characteristic of most of the species of this genus. The smoothness of the glabella and the large size of the glabellar lobes are, however, incompatible with the reference of this species to Ceraurus, and the course of the pair of posterior glabellar furrows excludes it from Cheirurus. As its characteristics are most nearly those of Ceraurinus, it is referred to that genus. The affinities of *Ceraurinus trentonensis* are most closely with a Russian species, an unidentified specimen of which is in the U. S. National Museum. From Schmidt's description of *Cheirurus ingricus* Schmidt[1] and of *Cheirurus ornatus* Dalman,[2] this specimen would seem to be closely allied to these species, but not to be identified with either. The affinities of *Ceraurinus trentonensis* may therefore also lie with these two Russian species.

FORMATION AND LOCALITY.— Curdsville bed, at the base of the Trenton, Goat Island, Manitoulin Islands, Lake Huron. The figured specimens are the property of the Geological Survey of Canada, and were collected by Dr. August F. Foerste.

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[1] Mem. Acad. imp. sci. St. Petersburg, 1881, ser. 7, **30**, no. 1, p. 135, pl. 6, fig. 1–2.

[2] Schmidt, *Loc. cit.*, p. 133, pl. 6, fig. 3–4, pl. 16, fig. 1.

An allied form is found at the same horizon at Kirkfield, Ontario. The two pairs of anterior glabellar furrows in this form are fainter, and the basal lobes of the glabella are more sharply isolated than in the specimens from Goat Island.

CERAURINUS SCOFIELDI (Clarke).

Plate, fig. 4.

Cyrtometopus scofieldi Clarke, Pal. Minn., 1897, **3**, pt. 2, p. 735.

The type of *Cyrtometopus scofieldi* Clarke shows only the cranidium. The specimen figured (Plate, fig. 4), presents, in addition, a free cheek, two thoracic segments, and a fragmentary pygidium. The free cheek is relatively large, is roughly triangular, and is only slightly convex. It has a relatively broad border, separated from the main portion of the cheek by a narrow lateral furrow. The axial portion of the thorax is, in width, slightly less than one third the total width. The pleura are divided into an inner and an outer portion by a faint constriction. The inner portion is cut by a diagonal furrow.

The diagonal pleural furrows, the parallel sides of the glabella, and the form and course of the pair of posterior glabellar furrows prevent the identification of this species as Cyrtometopus. These features, the furrow on the upper surface of the palpebral lobe, and the course of the neck-furrow, are the characteristics of Ceraurinus.

The specimen is apparently enrolled and the spines of the pygidium seem to project from beneath the front of the cephalon. There is one pair of relatively large spines enclosing a small notched plate. The pygidium is smaller than in the other species of the genus.

Ceraurinus scofieldi is apparently most closely allied to *Ceraurinus marginatus*, *C. icarus*, and *C. pompilius*. These four species are all characterized by the flatly cylindrical glabella with rounded front, and by posterior glabellar furrows of about the same pattern. The first three also agree in having the middle pair of glabellar furrows about at right angles to the axis of the glabella, and the anterior pair at a very slight angle, eyes similarly placed, palpebral lobes with a furrow on the upper surface, and a broad cephalic border. *Ceraurinus scofieldi* may be distinguished from *Ceraurinus marginatus* most readily by the greater inclination backward of the posterior pair of glabellar furrows of the former, the position of the eyes further back, and by a narrower cephalic border. From *Ceraurinus icarus* (Billings) it may be distinguished by the more complete separation of the basal lobes of the former, and from *Cheirurus pompilius* Billings by the more rectangular form of the basal lobes of the latter.

FORMATION AND LOCALITY.— Lower Trenton at Minneapolis, Minn., the Glades, Lebanon, Tenn.; Black River at Newport, N. Y. The specimen figured (M. C. Z. No. 13), is from the latter locality, and was collected by Dr. C. D. Walcott.

CERAURINUS CONFLUENS, sp. nov.

Plate, fig. 3.

This trilobite is known only from two fragmentary specimens of the cephalon. The general outline of the cephalon is semicircular. The glabella is, in width, about one third of the extreme width of the cephalon, is strikingly rectangular, but with rounded corners, a slightly rounded and a slightly concave posterior, and is moderately convex. The glabellar furrows are linear with sharply rounded edges, are about one third of the width of the glabella in length, and slope gently backward. The two anterior pairs of glabellar furrows open cleanly into dorsal furrows. The posterior pair, however, fail to cross the outer edge of the glabella, and at each end are separated from the dorsal furrow by about one sixteenth of the glabella. The eye is situated in the middle of the cheek and about opposite the second glabellar furrow. The posterior portion of the facial suture, running outward from the posterior of the eye, curves slightly forward and apparently cuts the margin about on a level with the eye. The anterior portion of the suture runs forward from the eye bending slightly inward. The glabella is smooth. The cheeks are perhaps faintly pitted. The neck-furrow is narrow and moderately deep. Its course is similar to those of the other members of the genus.

MEASUREMENTS.—

Length of cephalon	23 mm.
Half-width of cephalon	20 mm.
Width of glabella	13 mm.
Position of eye	
Ratio distance eye to posterior margin to length of cephalon	0.43
Ratio distance eye to glabella to length of cephalon	0.21

Remarks.— *Ceraurinus confluens* may be distinguished from all other species of the genus and of the other genera of the Cheiruridae by the fact that the posterior pair of glabellar furrows do not open into the dorsal furrows, but are separated from them by a narrow portion of the glabella.

Formation and locality.— *Ceraurinus confluens* is known only from the Picton (Upper Trenton). The type is from Pefferlaw, Ontario, and was collected by Mr. W. A. Johnston. It is now in the collections of the Victoria Memorial Museum of the Geological Survey of Canada. A second specimen was collected by Mr. E. J. Whittaker at the same horizon at Collingwood, Ontario.

PLATE.

Fig. 1. *Ceraurinus marginatus* Barton. A nearly complete, partially enrolled specimen, the type of the genus and species. The specimen, No. 12 Coll. M. C. Z., is from an unknown formation and locality in Ontario, Canada, but is supposed to have come from the Richmond on Manitoulin Island. Natural size.

Fig. 2. A cranidium of Cheirurus, No. 14 Coll. M. C. Z., introduced to show the character of the basal glabellar lobes in that genus. The specimen is from the Silurian at Wauwatosa, Wisconsin. Slightly less than natural size.

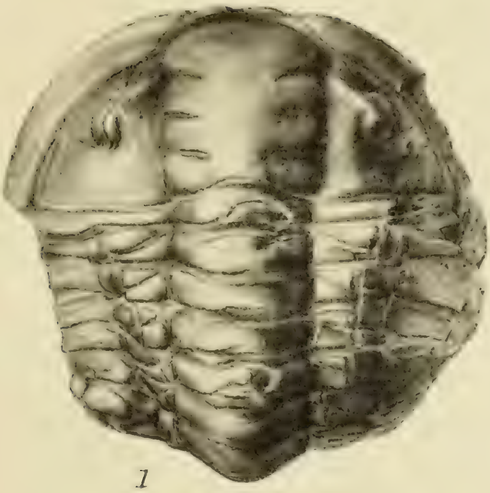
Fig. 3. *Ceraurinus confluens* Barton. The imperfect cranidium which is the holotype. The specimen was collected from the upper part of the Trenton at Pefferlaw, Ontario, and is in the Victoria Memorial Museum at Ottawa, Canada. The figure is one third larger than the specimen.

Fig. 4. *Ceraurinus scofieldi* (Clarke). An enrolled and partly dismembered specimen from the Leray-Black River at Newport, New York. The specimen is No. 13 Coll. M. C. Z., and the figure is twice natural size. The pygidium projects in front of the glabella, and presents its lower surface.

Fig. 5, 6. *Ceraurinus trentonensis* Barton. An imperfect cranidium and hypostoma from the lower part of the Trenton on Goat Island, Manitoulin Islands, Lake Huron. The specimens are on a single chip of limestone in the Victoria Memorial Museum at Ottawa, Ontario, and the figures are one third larger than natural size.

Fig. 7. *Ceraurinus icarus* (Billings). This figure is made from a copy of a photograph of the specimen figured by Meek, Paleontology of Ohio, **1**, plate 14, fig. 11a. The original photograph was made by Mote and Swaine of Richmond, Indiana. The specimen is the type of *Ceraurus meekanus* Miller.

Cheiruridae.



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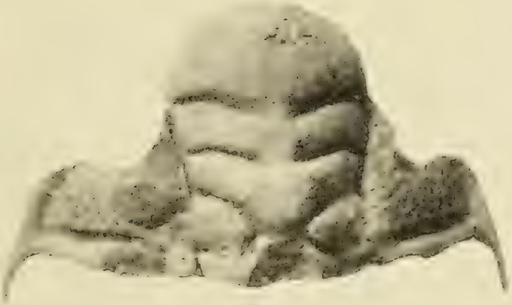

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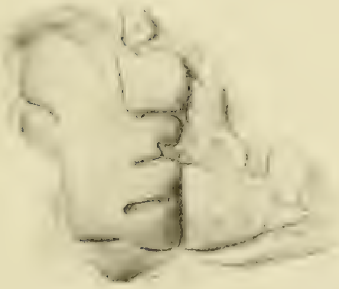

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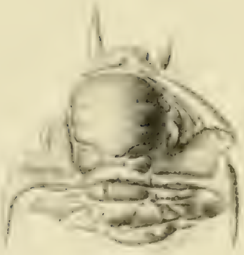

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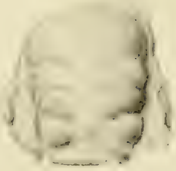

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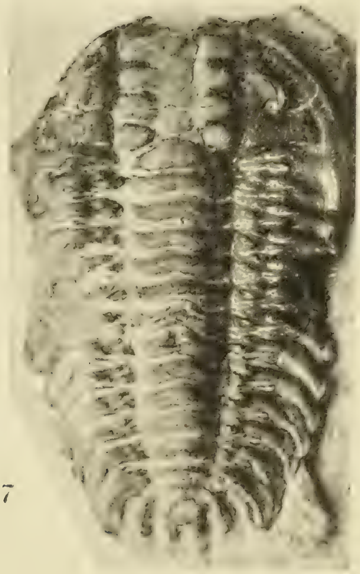

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